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(54) Title: ORGANIC ELECTROLUMINESCENT COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present disclosure relates to an organic electroluminescent compound represented by formula 1 and an organic electroluminescent device comprising the same. By comprising the organic electroluminescent compound according to the present disclosure, an organic electroluminescent device having low driving voltage and/or high luminous efficiency and long lifespan can be provided compared with the conventional organic electroluminescent device.

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Description

Title of Invention: ORGANIC ELECTROLUMINESCENT COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

Technical Field

[1] The present disclosure relates to an organic electroluminescent compound and an organic electroluminescent device comprising the same.

Background Art

[2] The TPD/Alq_3 bilayer small molecule organic electroluminescent device with green-emission, which is constituted with a light-emitting layer and a charge transport layer, was first developed by Tang, et al., of Eastman Kodak in 1987. Thereafter, the studies on an organic electroluminescent device have been rapidly commercialized. An organic electroluminescent device (OLED) changes electric energy into light by applying electricity to an organic electroluminescent material, and commonly comprises an anode, a cathode, and an organic layer formed between the two electrodes. An organic electroluminescent device has a multi-layer structure including a hole transport zone, a light-emitting layer, and an electron transport zone, etc., in order to improve its efficiency and stability.

[3] In addition, the studies on the new compounds capable of improving the performance of the organic electroluminescent device have been actively conducted since the performance of an organic electroluminescent device depends largely on the compound contained in each zone or layer thereof. For example, copper phthalocyanine (CuPc), 4,4′-bis[N-(1-naphthyl)-N-phenylamino]biphenyl (NPB), N,N′-diphenyl-N,N′-bis(3-methylphenyl)-(1,1′-biphenyl)-4,4′-diamine (TPD), 4,4′,4″-tris(3-methylphenylphenylamino)triphenylamine (MTDATA), etc., were used as a compound comprised in a hole transport zone in an organic electroluminescent device. However, an organic electroluminescent device using these materials has problems of reduction in luminous efficiency and lifespan. It is because, when an organic electroluminescent device is driven under high current, thermal stress occurs between an anode and a hole injection layer, thereby such thermal stress significantly reduces the lifespan of the device. Further, since the organic material used in the hole transport zone has very high hole mobility, there have been problems in that the hole-electron charge balance is broken and the quantum efficiency (cd/A) is lowered. Thus, new compounds that can replace the conventional compound used in a hole transport zone are necessary. In addition, the studies on various materials and devices for improving the luminous efficiency, the driving voltage and/or the lifespan charac-

teristics of the organic electroluminescent device have been conducted.

[4] KR 2017-0096770 A merely discloses a compound in which an amine is bonded to a specific position of benzonaphthothiophene or benzonaphthofuran as a compound comprised in a hole transport layer of an organic electroluminescent device.

Disclosure of Invention

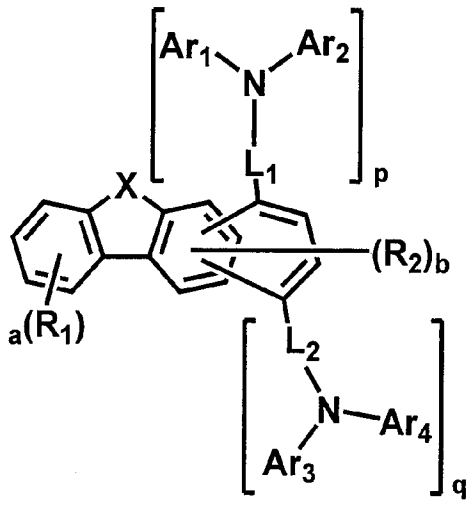
Technical Problem

[5] The object of the present disclosure is to provide an organic electroluminescent compound effective for producing an organic electroluminescent device having low driving voltage and/or high luminous efficiency and/or long lifespan.

Solution to Problem

[6] The present inventors found that the aforementioned objective can be achieved due to the organic electroluminescent compound represented by the following formula 1, which decreases the degree of free rotation and increases the rigidity of the molecule through the steric hindrance of the molecule without significantly changing the triplet energy, as compared with the compound disclosed in KR 2017-0096770 A, and then completed the present invention.

[7]



--- (1)

[8] In formula 1,

[9] X represents O or S;

[10] Ar_1 to Ar_4 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di-(C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or Ar_1 and Ar_2, and Ar_3 and Ar_4 may be linked to each other to form a ring;

[11] L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted

(C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;

[12] R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino;

[13] a represents an integer of 1 to 4, b represents an integer of 1 to 5, and when a and b are 2 or more, each of R_1 and each of R_2 may be the same or different; and

[14] p and q each independently represent 0 or 1, provided that the sum of p and q is 1 or 2, when the sum of p and q is 2, L_1 and L_2, and Ar_1 to Ar_4 may be the same or different.

Advantageous Effects of Invention

[15] The organic electroluminescent compound according to the present disclosure can provide an organic electroluminescent device having low driving voltage, high luminous efficiency, and/or long lifespan.

Mode for the Invention

[16] Hereinafter, the present disclosure will be described in detail. However, the following description is intended to explain the invention, and is not meant in any way to restrict the scope of the invention.

[17] The term "organic electroluminescent compound" in the present disclosure means a compound that may be used in an organic electroluminescent device, and may be comprised in any material layer constituting an organic electroluminescent device, as necessary.

[18] The term "organic electroluminescent material" in the present disclosure means a material that may be used in an organic electroluminescent device, and may comprise at least one compound. The organic electroluminescent material may be comprised in any layer constituting an organic electroluminescent device, as necessary. For example, the organic electroluminescent material may be a hole injection material, a hole transport material, a hole auxiliary material, a light-emitting auxiliary material, an electron blocking material, a light-emitting material, an electron buffer material, a hole blocking material, an electron transport material, or an electron injection material, etc.

[19] The term "a hole transport zone" means a zone where holes move between the first electrode and the light-emitting layer. For example, the hole transport zone may include at least one of a hole injection layer, a hole transport layer, a hole auxiliary layer, a light-emitting auxiliary layer, and an electron blocking layer. The hole

injection layer, the hole transport layer, the hole auxiliary layer, the light-emitting auxiliary layer, and the electron blocking layer may each be a single layer or multi-layers in which two or more layers are stacked. According to one embodiment, the hole transport zone may include a first hole transport layer and a second hole transport layer. The second hole transport layer may be at least one layer of a plurality of hole transport layers and includes at least one of a hole auxiliary layer, a light-emitting auxiliary, and/or an electron blocking layer. Further, according to another embodiment, the hole transport zone may include a first hole transport layer and a second hole transport layer. The first hole transport layer may be placed between the first electrode and the light-emitting layer and the second hole transport layer may be placed between the first hole transport layer and the light-emitting layer. The second hole transport layer may be a role of a hole transport layer, a light-emitting auxiliary, a hole auxiliary layer and/or an electron blocking layer.

[20] The hole transport layer may be placed between the anode (or hole injection layer) and a light-emitting layer, and may function to smoothly move the holes transferred from the anode to the light-emitting layer and to block the electrons transferred from the cathode to remain in the light-emitting layer. The light-emitting auxiliary layer may be placed between the anode and the light-emitting layer, or between the cathode and the light-emitting layer. When the light-emitting auxiliary layer is placed between the anode and the light-emitting layer, it can be used for promoting the hole injection and/or the hole transport, or for preventing the overflow of electrons. When the light-emitting auxiliary layer is placed between the cathode and the light-emitting layer, it can be used for promoting the electron injection and/or the electron transport, or for preventing the overflow of holes. In addition, the hole auxiliary layer may be placed between the hole transport layer (or hole injection layer) and the light-emitting layer, and may be effective to promote or block the hole transport rate (or the hole injection rate), thereby enabling the charge balance to be controlled.

[21] Also, the electron blocking layer may be placed between the hole transport layer (or hole injection layer) and the light-emitting layer, and can confine the excitons within the light-emitting layer by blocking the overflow of electrons from the light-emitting layer to prevent a light-emitting leakage. When the organic electroluminescent device contains two or more hole transport layers, the hole transport layer, which is further included, can be used for a light-emitting auxiliary layer, a hole auxiliary layer, and an electron blocking layer, etc. The light-emitting auxiliary layer, the hole auxiliary layer, and/or the electron blocking layer may have an effect of improving the luminous efficiency and/or lifespan of the organic electroluminescent device.

[22] Herein, "(C1-C30)alkyl" is meant to be a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably

1 to 20, and more preferably 1 to 10. The above alkyl may include methyl, ethyl, n-propyl, isopropyl, *n*-butyl, isobutyl, *tert*-butyl, etc. "(C2-C30)alkenyl" is a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc. "(C2-C30)alkynyl" is a linear or branched alkynyl having 2 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes ethynyl, 1-propynyl, 2-propynyl, 1-butynyl, 2-butynyl, 3-butynyl, 1-methylpent-2-ynyl, etc. "(C3-C30)cycloalkyl" is a mono- or polycyclic hydrocarbon having 3 to 30 ring backbone carbon atoms, in which the number of carbon atoms is preferably 3 to 20, and more preferably 3 to 7. The above cycloalkyl may include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. "(3- to 7-membered)heterocycloalkyl" is a cycloalkyl having 3 to 7 ring backbone atoms, in which the number of ring backbone atoms is preferably 5 to 7, including at least one heteroatom selected from the group consisting of B, N, O, S, Si, and P, preferably, O, S and N. The above heterocycloalkyl may include tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc. "(C6-C30)aryl(ene)" is a monocyclic or fused ring radical derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of the ring backbone carbon atoms is preferably 6 to 20, more preferably 6 to 15, may be partially saturated, and may comprise a spiro structure. Examples of the aryl specifically include phenyl, biphenyl, terphenyl, quaterphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, dimethylfluorenyl, diphenylfluorenyl, benzofluorenyl, diphenylbenzofluorenyl, dibenzofluorenyl, phenanthrenyl, benzophenanthrenyl, phenylphenanthrenyl, anthracenyl, benzanthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, benzochrysenyl, naphthacenyl, fluoranthenyl, benzofluoranthenyl, tolyl, xylyl, mesityl, cumenyl, spiro[fluorene-fluorene]yl, spiro[fluorene-benzofluorene]yl, azulenyl, etc. More specifically, the aryl may be o-tolyl, m-tolyl, p-tolyl, 2,3-xylyl, 3,4-xylyl, 2,5-xylyl, mesityl, o-cumenyl, m-cumenyl, p-cumenyl, p-t-butylphenyl, p-(2-phenylpropyl)phenyl, 4'-methylbiphenyl, 4"-t-butyl-p-terphenyl-4-yl, o-biphenyl, m-biphenyl, p-biphenyl, o-terphenyl, m-terphenyl-4-yl, m-terphenyl-3-yl, m-terphenyl-2-yl, p-terphenyl-4-yl, p-terphenyl-3-yl, p-terphenyl-2-yl, m-quaterphenyl, 1-naphthyl, 2-naphthyl, 1-fluorenyl, 2-fluorenyl, 3-fluorenyl, 4-fluorenyl, 9-fluorenyl, 9,9-dimethyl-1-fluorenyl, 9,9-dimethyl-2-fluorenyl, 9,9-dimethyl-3-fluorenyl, 9,9-dimethyl-4-fluorenyl, 9,9-diphenyl-1-fluorenyl, 9,9-diphenyl-2-fluorenyl, 9,9-diphenyl-3-fluorenyl, 9,9-diphenyl-4-fluorenyl, 1-anthryl, 2-anthryl, 9-anthryl, 1-phenanthryl, 2-phenanthryl, 3-phenanthryl, 4-phenanthryl, 9-phenanthryl, 1-chrysenyl, 2-chrysenyl, 3-chrysenyl, 4-chrysenyl, 5-chrysenyl, 6-chrysenyl,

benzo[c]phenanthryl, benzo[g]chrysenyl, 1-triphenylenyl, 2-triphenylenyl, 3-triphenylenyl, 4-triphenylenyl, 3-fluoranthenyl, 4-fluoranthenyl, 8-fluoranthenyl, 9-fluoranthenyl, benzofluoranthenyl, etc.

[23] Herein, "(3- to 30-membered)heteroaryl(ene)" is an aryl having 3 to 30 ring backbone atoms, in which the number of ring backbone atoms is preferably 5 to 25, including at least one, preferably 1 to 4 heteroatoms selected from the group consisting of B, N, O, S, Si, P, and Ge. The above heteroaryl may be a monocyclic ring, or a fused ring condensed with at least one benzene ring; and may be partially saturated. The above heteroatom may be linked with at least one substituent selected from the group consisting of hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, and a substituted or unsubstituted (C1-C30)alkyl(C6-30)arylamino. Also, the above heteroaryl may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and may comprise a spiro structure. Examples of the heteroaryl specifically may include a monocyclic ring-type heteroaryl including furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl including benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, imidazopyridinyl, isoindolyl, indolyl, benzoindolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, azacarbazolyl, benzocarbazolyl, dibenzocarbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, indolizidinyl, acrylidinyl, silafluorenyl, germafluorenyl, etc. More specifically, the heteroaryl may be 1-pyrrolyl, 2-pyrrolyl, 3-pyrrolyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 6-pyrimidinyl, 1,2,3-triazin-4-yl, 1,2,4-triazin-3-yl, 1,3,5-triazin-2-yl, 1-imidazolyl, 2-imidazolyl, 1-pyrazolyl, 1-indolizidinyl, 2-indolizidinyl, 3-indolizidinyl, 5-indolizidinyl, 6-indolizidinyl, 7-indolizidinyl, 8-indolizidinyl, 2-imidazopyridinyl, 3-imidazopyridinyl, 5-imidazopyridinyl, 6-imidazopyridinyl, 7-imidazopyridinyl, 8-imidazopyridinyl, 1-indolyl, 2-indolyl, 3-indolyl, 4-indolyl, 5-indolyl, 6-indolyl,

7-indolyl, 1-isoindolyl, 2-isoindolyl, 3-isoindolyl, 4-isoindolyl, 5-isoindolyl, 6-isoindolyl, 7-isoindolyl, 2-furyl, 3-furyl, 2-benzofuranyl, 3-benzofuranyl, 4-benzofuranyl, 5-benzofuranyl, 6-benzofuranyl, 7-benzofuranyl, 1-isobenzofuranyl, 3-isobenzofuranyl, 4-isobenzofuranyl, 5-isobenzofuranyl, 6-isobenzofuranyl, 7-isobenzofuranyl, 2-quinolyl, 3-quinolyl, 4-quinolyl, 5-quinolyl, 6-quinolyl, 7-quinolyl, 8-quinolyl, 1-isoquinolyl, 3-isoquinolyl, 4-isoquinolyl, 5-isoquinolyl, 6-isoquinolyl, 7-isoquinolyl, 8-isoquinolyl, 2-quinoxalinyl, 5-quinoxalinyl, 6-quinoxalinyl, 1-carbazolyl, 2-carbazolyl, 3-carbazolyl, 4-carbazolyl, 9-carbazolyl, azacarbazole-1-yl, azacarbazole-2-yl, azacarbazole-3-yl, azacarbazole-4-yl, azacarbazole-5-yl, azacarbazole-6-yl, azacarbazole-7-yl, azacarbazole-8-yl, azacarbazole-9-yl, 1-phenanthridinyl, 2-phenanthridinyl, 3-phenanthridinyl, 4-phenanthridinyl, 6-phenanthridinyl, 7-phenanthridinyl , 8-phenanthridinyl, 9-phenanthridinyl, 10-phenanthridinyl, 1-acrylidinyl, 2-acrylidinyl, 3-acrylidinyl, 4-acrylidinyl, 9-acrylidinyl, 2-oxazolyl, 4-oxazolyl, 5-oxazolyl, 2-oxadiazolyl, 5-oxadiazolyl, 3-furazanyl, 2-thienyl, 3-thienyl, 2-methylpyrrole-1-yl, 2-methylpyrrole-3-yl, 2-methylpyrrole-4-yl, 2-methylpyrrole-5-yl, 3-methylpyrrole-1-yl, 3-methylpyrrole-2-yl, 3-methylpyrrole-4-yl, 3-methylpyrrole-5-yl, 2-t-butylpyrrole-4-yl, 3-(2-phenylpropyl)pyrrole-1-yl, 2-methyl-1-indolyl, 4-methyl-1-indolyl, 2-methyl-3-indolyl, 4-methyl-3-indolyl, 2-t-butyl-1-indolyl, 4-t-butyl-1-indolyl, 2-t-butyl-3-indolyl, 4-t-butyl-3-indolyl, 1-dibenzofuranyl, 2-dibenzofuranyl, 3-dibenzofuranyl, 4-dibenzofuranyl, 1-dibenzothiophenyl, 2-dibenzothiophenyl, 3-dibenzothiophenyl, 4-dibenzothiophenyl, 1-silafluorenyl, 2-silafluorenyl, 3-silafluorenyl, 4-silafluorenyl, 1-germafluorenyl, 2-germafluorenyl, 3-germafluorenyl, and 4-germafluorenyl, etc. "Halogen" includes F, Cl, Br, and I.

[24] Herein, "ortho (o)," "meta (m)," and "para (p)" are meant to signify the substitution position of all substituents. Ortho position is a compound with substituents, which are adjacent to each other, e.g., at the 1 and 2 positions on benzene. Meta position is the next substitution position of the immediately adjacent substitution position, e.g., a compound with substituents at the 1 and 3 positions on benzene. Para position is the next substitution position of the meta position, e.g., a compound with substituents at the 1 and 4 positions on benzene.

[25] In addition, "substituted" in the expression "substituted or unsubstituted" means that a hydrogen atom in a certain functional group is replaced with another atom or functional group, i.e., a substituent. The substituents of the substituted (C1-C30)alkyl, the substituted (C6-C30)aryl(ene), the substituted (3-to 30-membered)heteroaryl(ene), the substituted (C3-C30)cycloalkyl, the substituted (C1-C30)alkoxy, the substituted tri(C1-C30)alkylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the sub-

stituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted tri(C6-C30)arylsilyl, the substituted mono- or di- (C1-C30)alkylamino, the substituted mono- or di-(C6-C30)arylamino, and the substituted (C1-C30)alkyl(C6-C30)arylamino each independently are at least one selected from the group consisting of deuterium, halogen, cyano, carboxyl, nitro, hydroxyl, (C1-C30)alkyl, halo(C1-C30)alkyl, (C2-C30)alkenyl, (C2-C30)alkynyl, (C1-C30)alkoxy, (C1-C30)alkylthio, (C3-C30)cycloalkyl, (C3-C30)cycloalkenyl, (3- to 7-membered)heterocycloalkyl, (C6-C30)aryloxy, (C6-C30)arylthio, (C6-C30)aryl-substituted or unsubstituted (3- to 30-membered)heteroaryl, (3- to 30-membered)heteroaryl-substituted or unsubstituted (C6-C30)aryl, tri(C1-C30)alkylsilyl, tri(C6-C30)arylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, (C1-C30)alkyldi(C6-C30)arylsilyl, amino, mono- or di- (C1-C30)alkylamino, (C1-C30)alkyl-substituted or unsubstituted mono- or di-(C6-C30)arylamino, (C1-C30)alkyl(C6-C30)arylamino, (C1-C30)alkylcarbonyl, (C1-C30)alkoxycarbonyl, (C6-C30)arylcarbonyl, di(C6-C30)arylboronyl, di(C1-C30)alkylboronyl, (C1-C30)alkyl(C6-C30)arylboronyl, (C6-C30)ar(C1-C30)alkyl, and (C1-C30)alkyl(C6-C30)aryl. According to one embodiment, the substituents each independently represent (C1-C20)alkyl and/or (C6-C25)aryl. According to another embodiment, the substituents each independently represent at least one of (C1-C10)alkyl and (C6-C18)aryl. For example, the substituents each independently may be at least one of methyl, phenyl, naphthyl, and biphenyl.

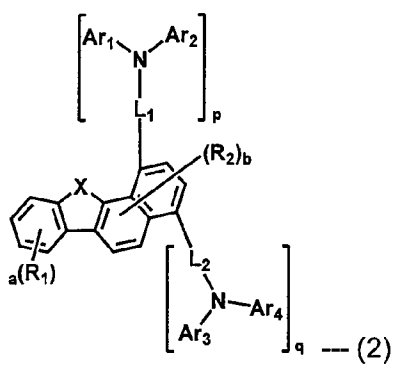
[26] Herein, "a ring formed by linked to an adjacent substituent" means a substituted or unsubstituted (3- to 30-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof, formed by linking or fusing two or more adjacent substituents; preferably, may be a substituted or unsubstituted (3- to 26-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof. In addition, the formed ring may contain at least one heteroatom selected from the group consisting of B, N, O, S, Si, and P, preferably, N, O, and S.

[27] In the formulae of the present disclosure, heteroaryl(ene) and heterocycloalkyl each independently may contain at least one heteroatom selected from the group consisting of B, N, O, S, Si P, and Ge. Further, the above heteroatom may be linked with at least one substituent selected from the group consisting of hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl,

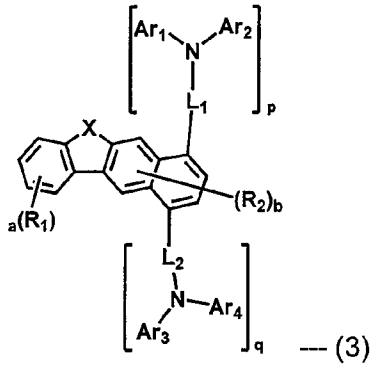
a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, and a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino.

[28] The compound represented by the formula 1 may be represented by any one of the following formulae 2 to 4.

[29]

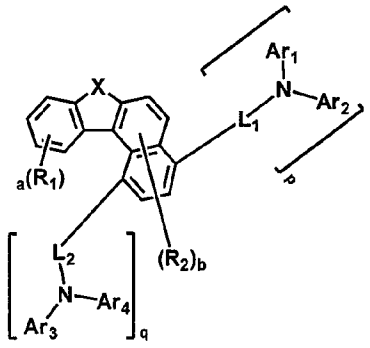


--- (2)



--- (3)

[30]



--- (4)

[31] In formulae 2 to 4, X, Ar_1 to Ar_4, L_1, L_2, R_1, R_2, a, b, p and q are as defined in formula 1. According to one embodiment, the sum of p and q may be 1.

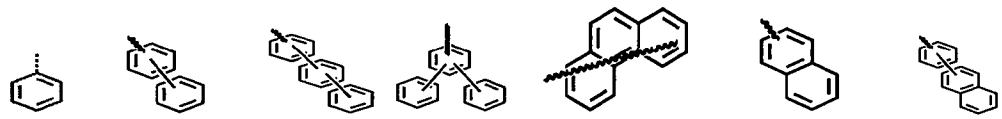
[32] In formulae 1 to 4, X represents O or S.

[33] In formulae 1 to 4, Ar_1 to Ar_4 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or Ar_1 and Ar_2 may be linked to each other to form a ring, and Ar_3 and Ar_4 may be linked to each other to form a ring. According to one embodiment, Ar_1 to Ar_4 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C6-C25)aryl, a substituted or unsubstituted (3- to 25-membered)heteroaryl, a substituted or unsubstituted mono- or di- (C1-C20)alkylamino, a substituted or unsubstituted mono- or di- (C6-C25)arylamino, or a substituted or unsubstituted (C1-C20)alkyl(C6-C25)arylamino. According to another embodiment, Ar_1 to Ar_4 each independently represent a substituted or unsubstituted (C1-C10)alkyl, a substituted or

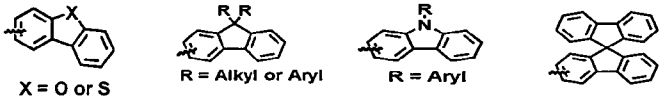
unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl. For example, Ar_1 to Ar_4 each independently may be an unsubstituted phenyl, an unsubstituted naphthyl, an unsubstituted biphenyl, an unsubstituted phenanthrenyl, an unsubstituted naphthylphenyl, phenyl-substituted or unsubstituted dimethylfluorenyl, an unsubstituted diphenylfluorenyl, an unsubstituted terphenyl, spirobifluorenyl, phenyl-substituted or unsubstituted dibenzothiophenyl, dibenzofuranyl, or at least one phenyl- and/or at least one biphenyl-substituted carbazolyl.

[34] According to one embodiment, Ar_1 and Ar_2, or Ar_3 and Ar_4 each independently may be selected from the following group. For example, when Ar_1 is phenyl, Ar_2 may be any one of the following compounds.

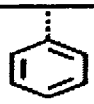
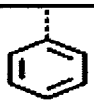
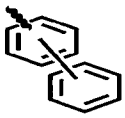
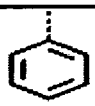
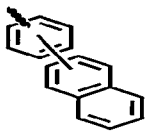
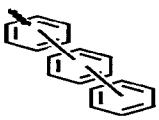
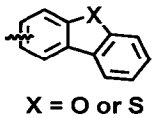
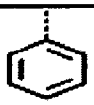
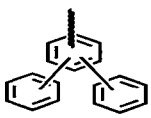
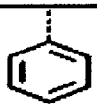
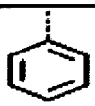
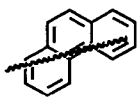
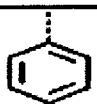
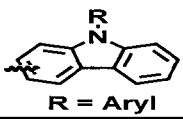
[35]



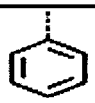
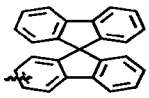
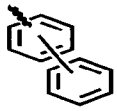
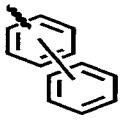
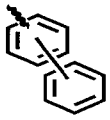
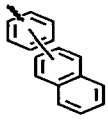
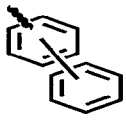
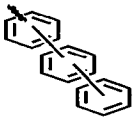
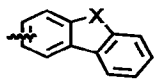
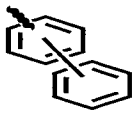
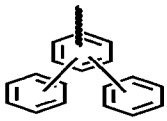
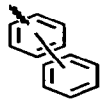
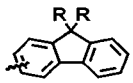
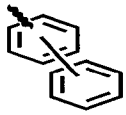
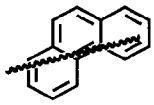
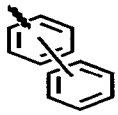
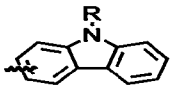
[36]



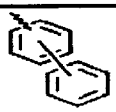
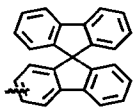
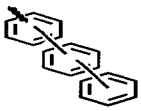
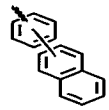
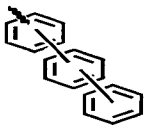
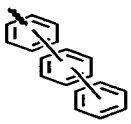
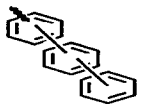
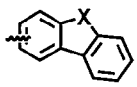
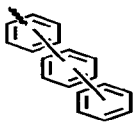
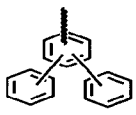
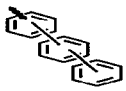
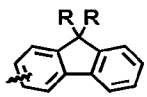
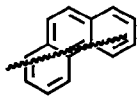
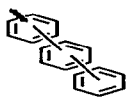
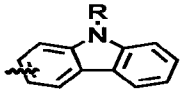
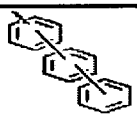
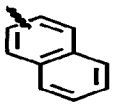
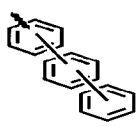
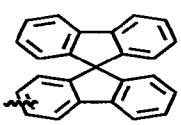
[37]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
			
			
			 X = O or S
			 R = Alkyl or Aryl
			 R = Aryl

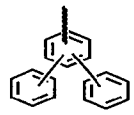
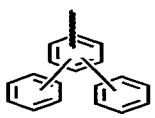
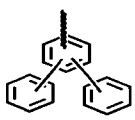
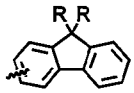
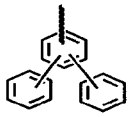
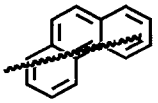
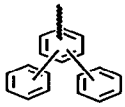
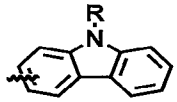
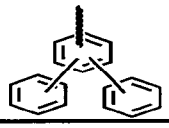
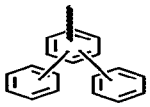
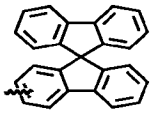
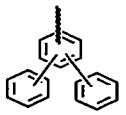
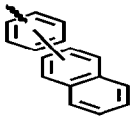
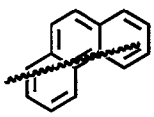
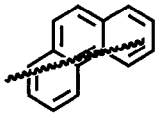
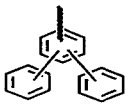
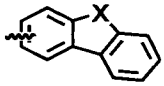
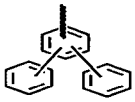
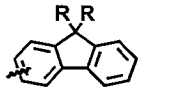
[38]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
			
			
			 X = O or S
			 R = Alkyl or Aryl
			 R = Aryl

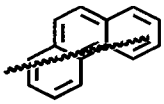
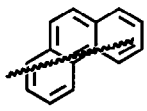
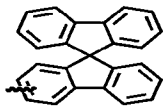
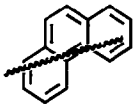
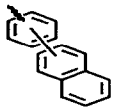
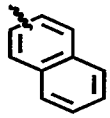
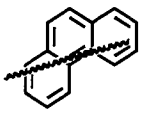
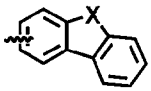
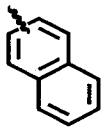
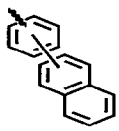
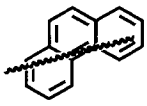
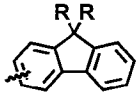
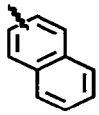
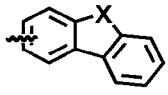
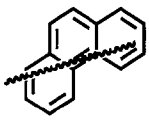
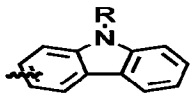
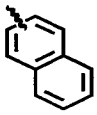
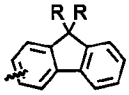
[39]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
			
			 X = O or S
			 R = Alkyl or Aryl
			 R = Aryl
			

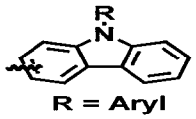
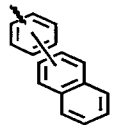
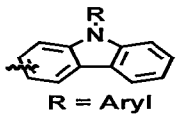
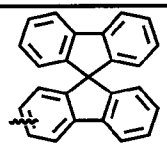
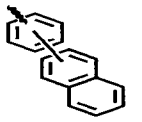
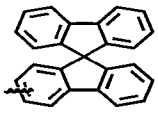
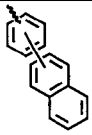
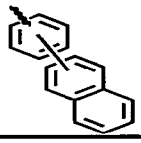
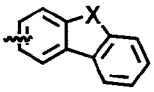
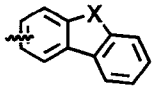
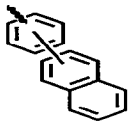
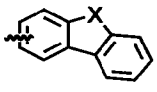
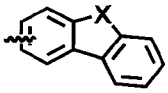
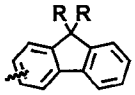
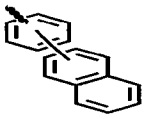
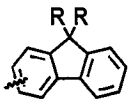
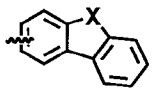
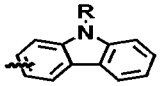
[40]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
			 R = Alkyl or Aryl
			 R = Aryl
			
			
	 X = O or S		 R = Alkyl or Aryl

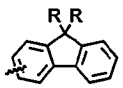
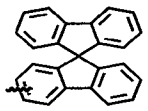
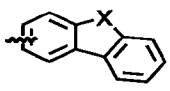
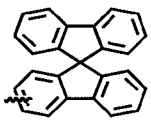
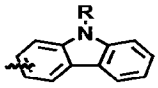
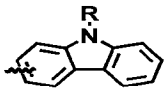
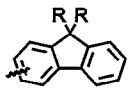
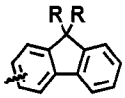
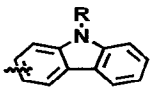
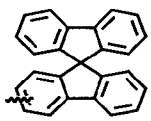
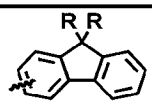
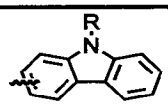
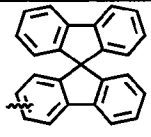
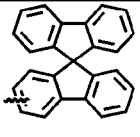
[41]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
			
			
	 X = O or S		
	 R = Alkyl or Aryl		 X = O or S
	 R = Aryl		 R = Alkyl or Aryl

[42]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
	 R = Aryl		 R = Aryl
			
		 X = O or S	 X = O or S
	 X = O or S	 X = O or S	 R = Alkyl or Aryl
	 R = Alkyl or Aryl	 X = O or S	 R = Aryl

[43]

Ar_1 (or Ar_3)	Ar_2 (or Ar_4)	Ar_1 (or Ar_3)	Ar_2 (or Ar_4)
 R = Alkyl or Aryl		 X = O or S	
 R = Aryl	 R = Aryl	 R = Alkyl or Aryl	 R = Alkyl or Aryl
 R = Aryl		 R = Alkyl or Aryl	 R = Aryl
			

[44] In formulae 1 to 4, L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene; according to one embodiment, L_1 and L_2 each inde-

pendently represent a single bond, a substituted or unsubstituted (C6-C25)arylene, or a substituted or unsubstituted (3- to 25-membered)heteroarylene; according to another embodiment, L_1 and L_2 each independently represent a single bond, an unsubstituted (C6-C18)arylene, or an unsubstituted (3- to 18-membered)heteroarylene. For example, L_1 and L_2 each independently may be a single bond, an unsubstituted phenylene, or an unsubstituted naphthylene.

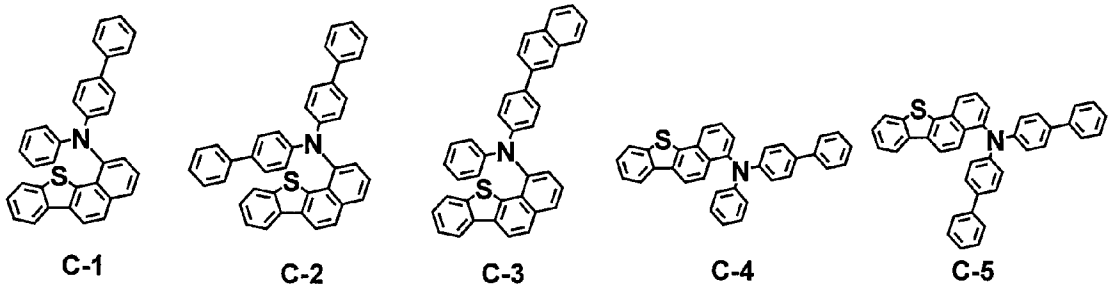
[45] In formulae 1 to 4, R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; according to one embodiment, R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (3- to 25-membered)heteroaryl; according to another embodiment, R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, an unsubstitued (C1-C10)alkyl, an unsubstitued (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl. For example, R_1 and R_2 may be hydrogen.

[46] In formulae 1 to 4, a represents an integer of 1 to 4, b represents an integer of 1 to 5, when a and b each are 2 or more, each of R_1 and each of R_2 may be the same or different; and according to one embodiment, a and b may be 1.

[47] In formulae 1 to 4, p and q each independently represent 0 or 1, provided that the sum of p and q is 1 or 2, when the sum of p and q is 2, each of the substituents may be the same or different; and according to one embodiment, the sum of p and q may be 1. For example, when p is 0, q is 1; and when p is 1, q is 0.

[48] The compound represented by formula 1 may be more specifically illustrated by the following compounds, but is not limited thereto.

[49]



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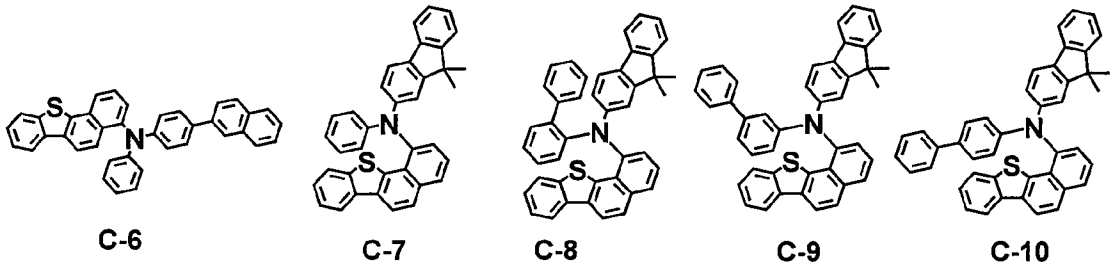
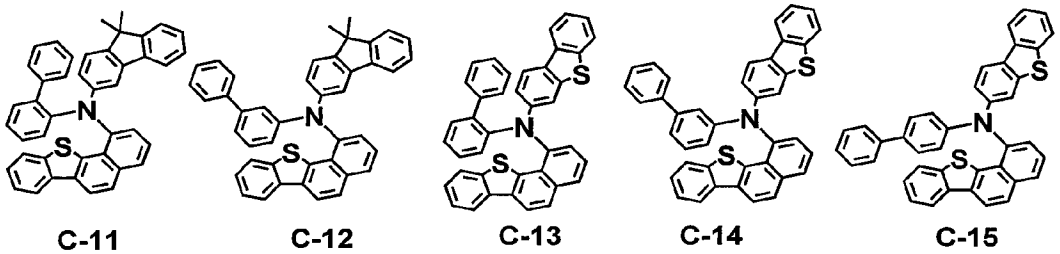


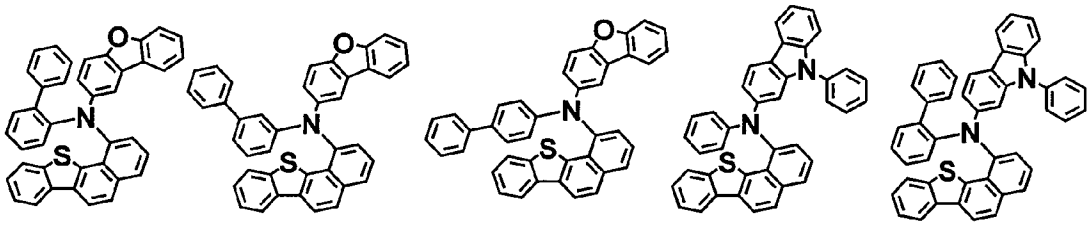
C-6 C-7 C-8 C-9 C-10

[51]



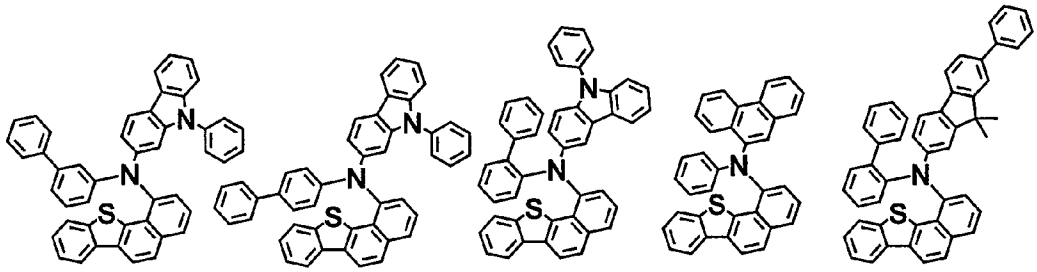
C-11 C-12 C-13 C-14 C-15

[52]



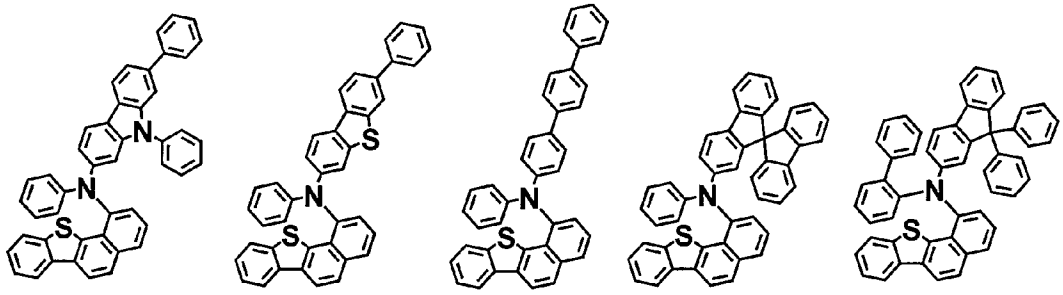
C-16 C-17 C-18 C-19 C-20

[53]



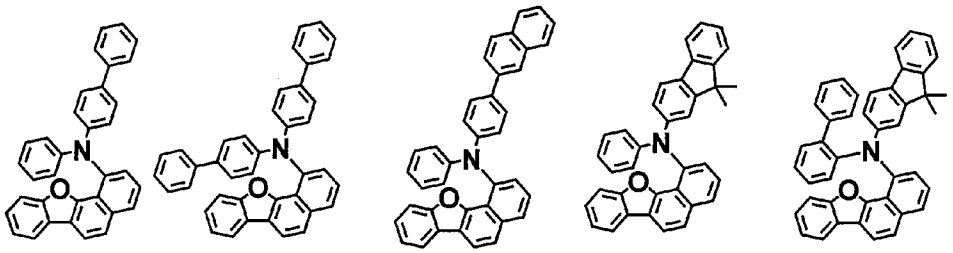
C-21 C-22 C-23 C-24 C-25

[54]



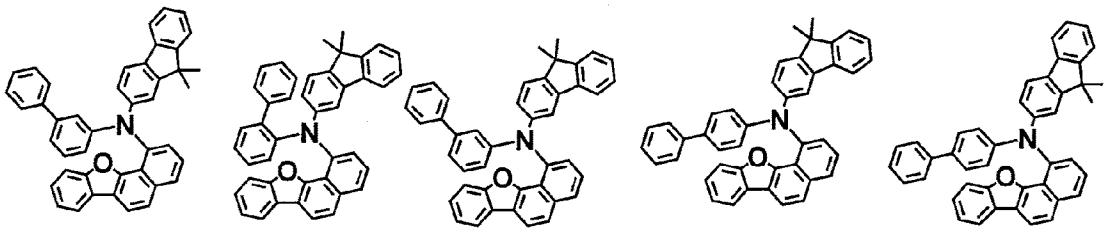
C-26 C-27 C-28 C-29 C-30

[55]



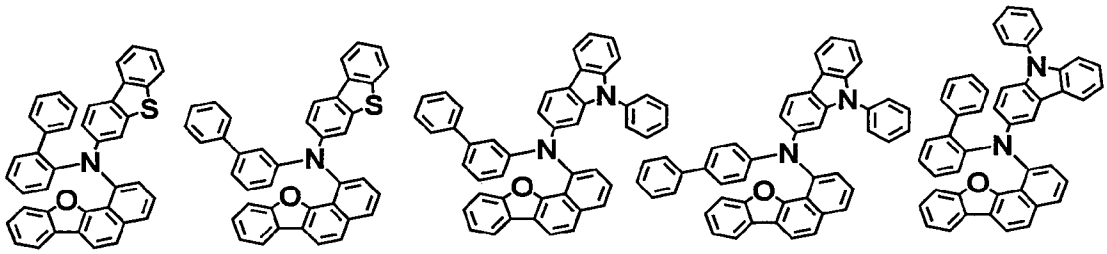
C-31 C-32 C-33 C-34 C-35

[56]



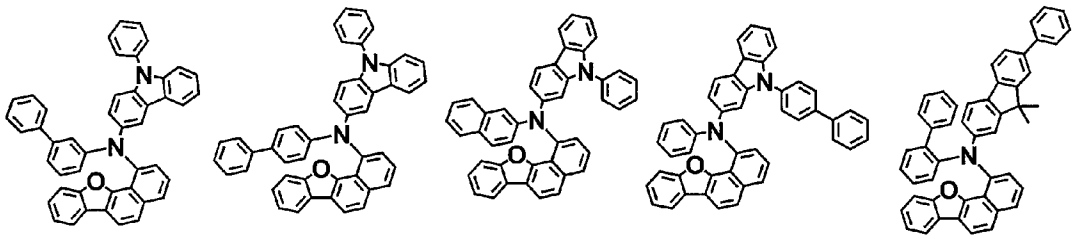
C-36 C-37 C-38 C-39 C-40

[57]



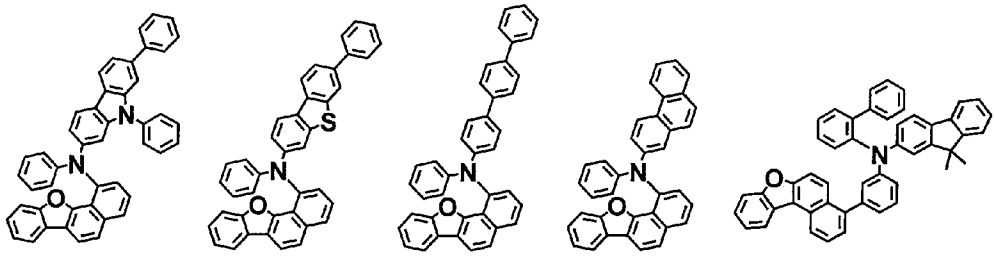
C-41 C-42 C-43 C-44 C-45

[58]



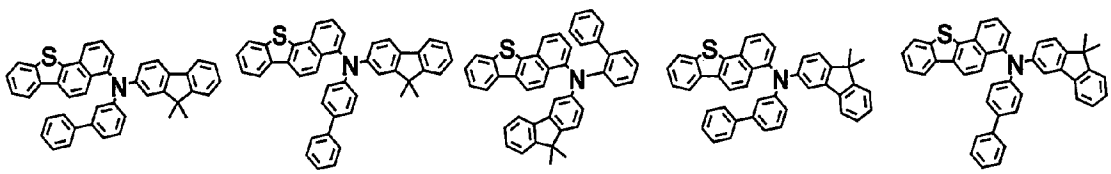
C-46 C-47 C-48 C-49 C-50

[59]



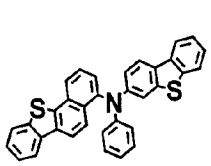
C-51 C-52 C-53 C-54 C-55

[60]



C-56 C-57 C-58 C-59 C-60

[61]



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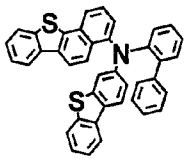

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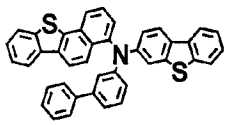

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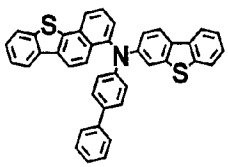
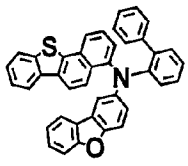


C-64



C-65

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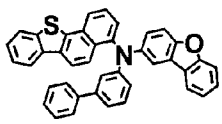

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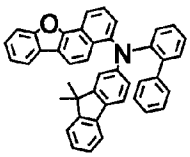

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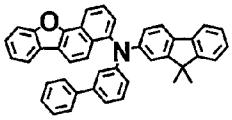

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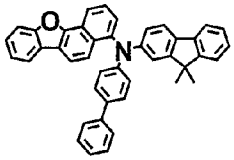

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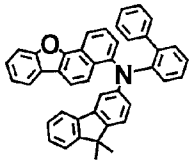
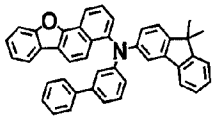


C-70

[63]



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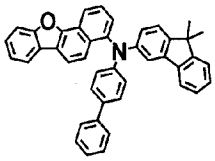

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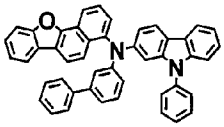

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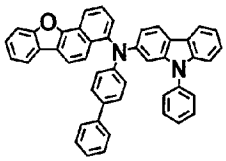

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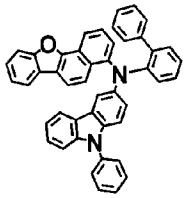

C-75

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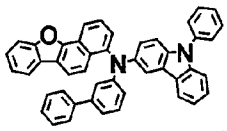
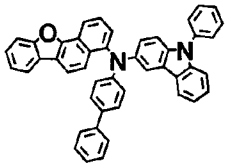


C-76



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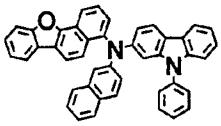

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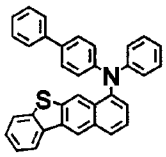

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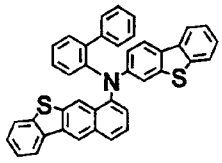

C-80

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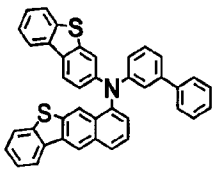

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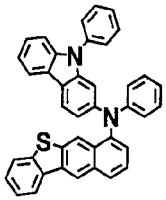

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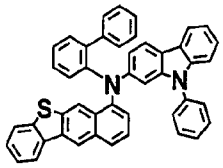

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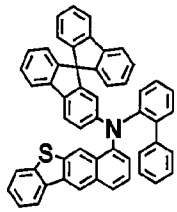

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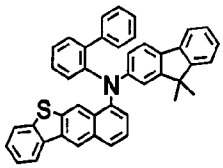

C-85

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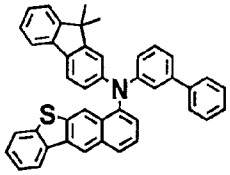
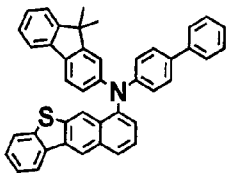


C-86



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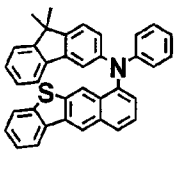

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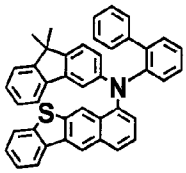

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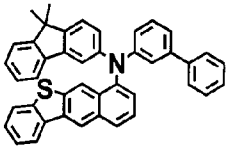

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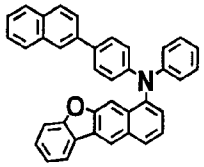

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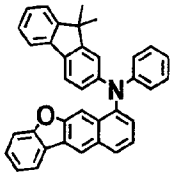

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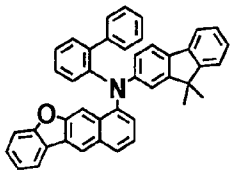

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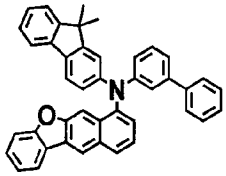

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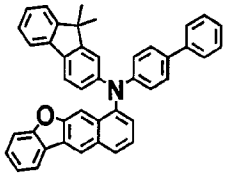

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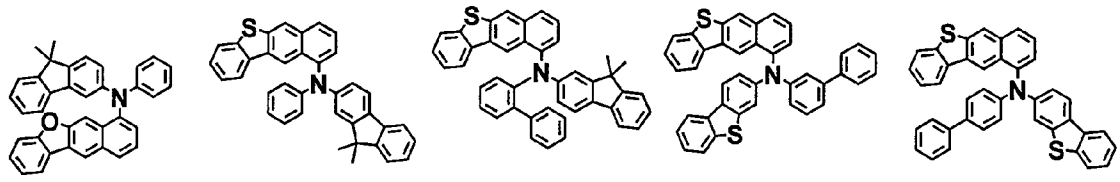

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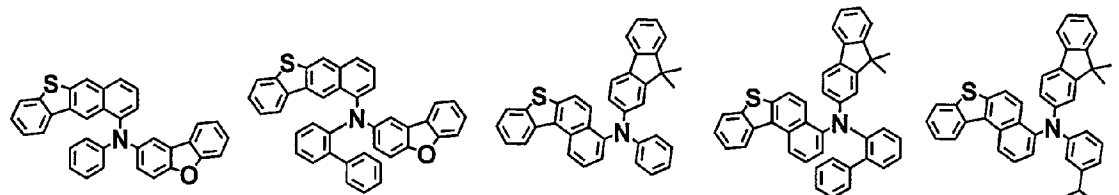

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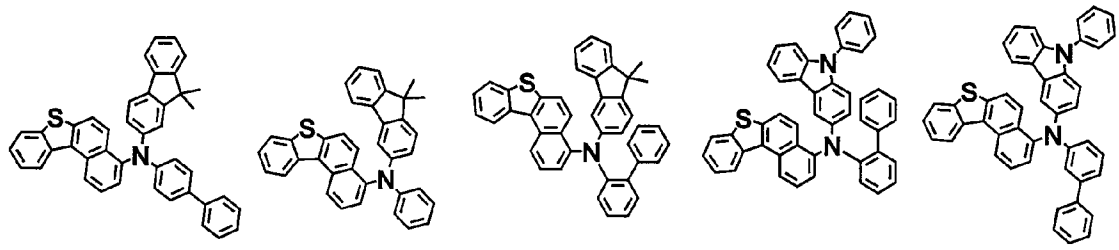

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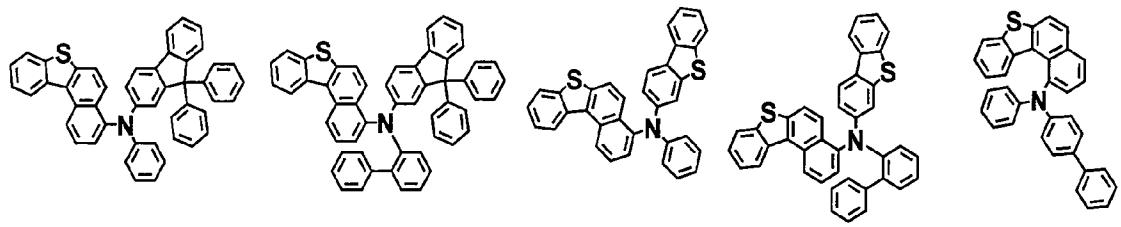

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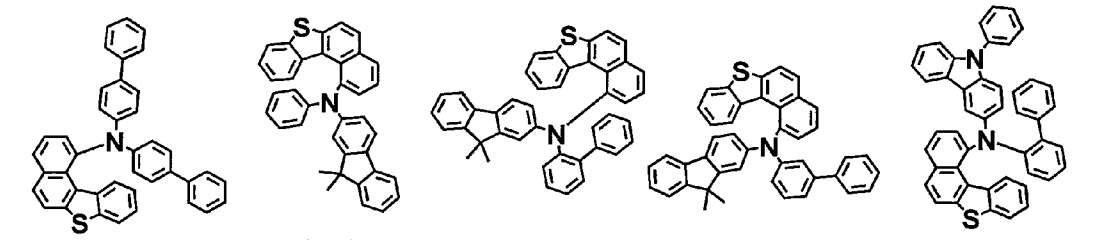

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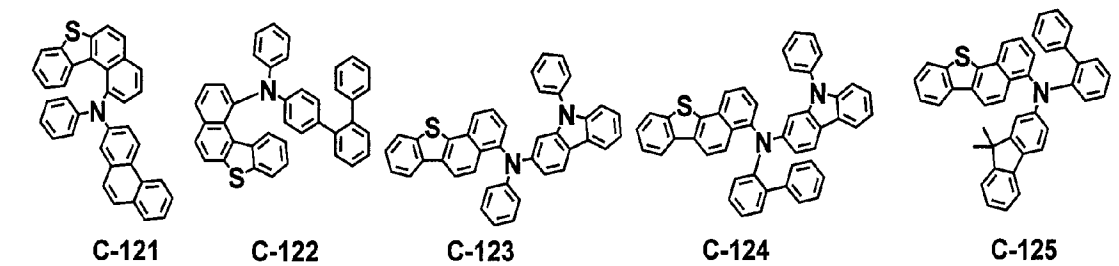

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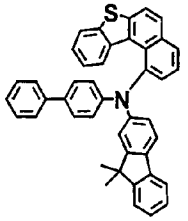
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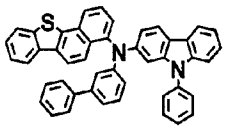
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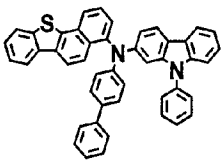
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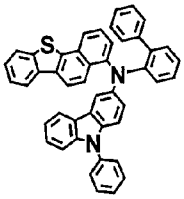
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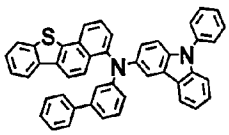
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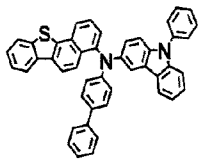
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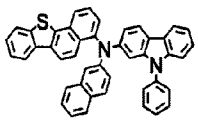
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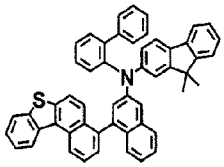
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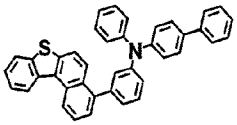
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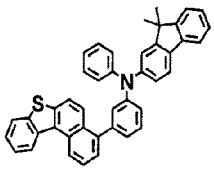
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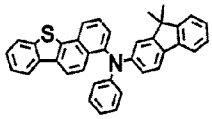
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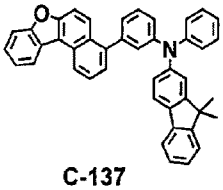
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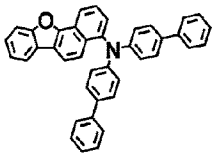
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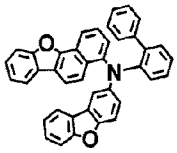
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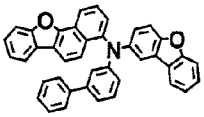
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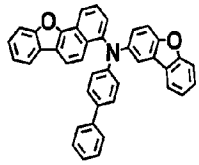
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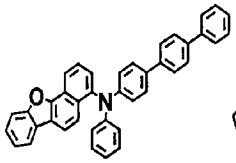
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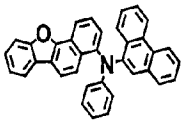
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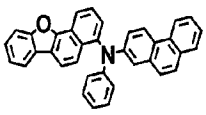
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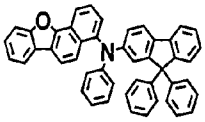
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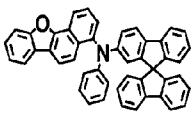
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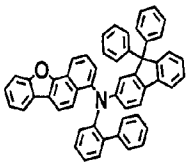
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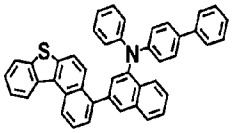
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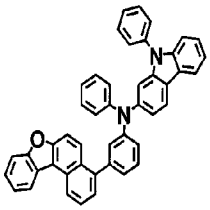
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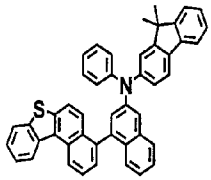
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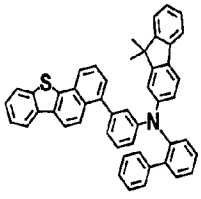
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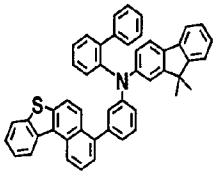
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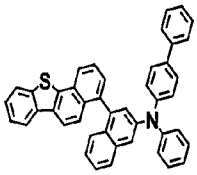
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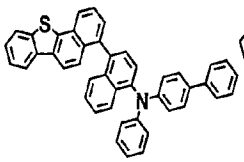
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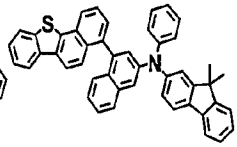
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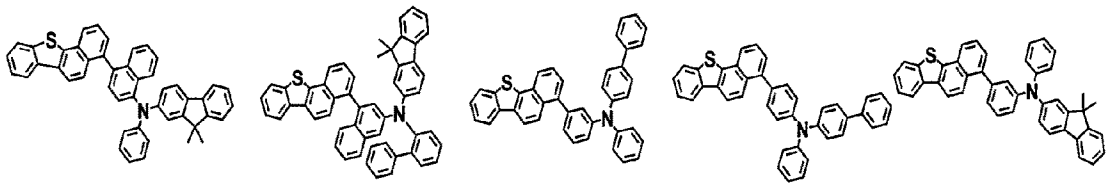

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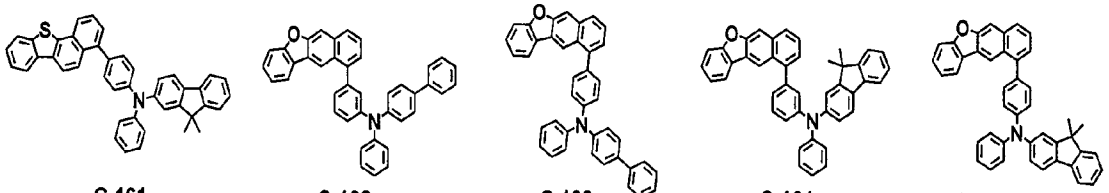

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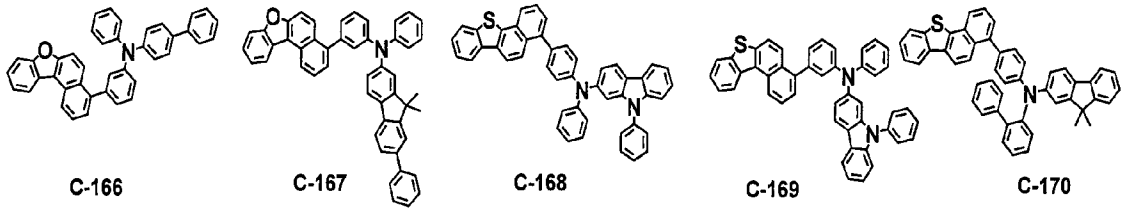

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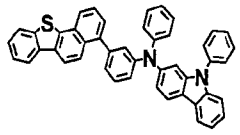

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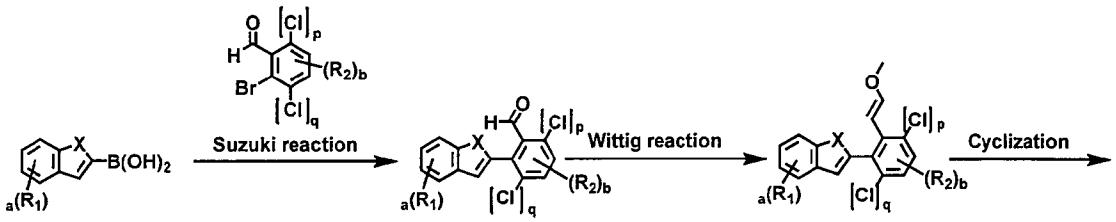
[84] The organic electroluminescent compound of the present disclosure may be produced by a synthetic method known to a person skilled in the art. For example, the organic electroluminescent compound of the present disclosure may be synthesized as represented by the following reaction schemes 1 to 3, but is not limited thereto.

[85] **[Reaction Scheme 1]**

[86]



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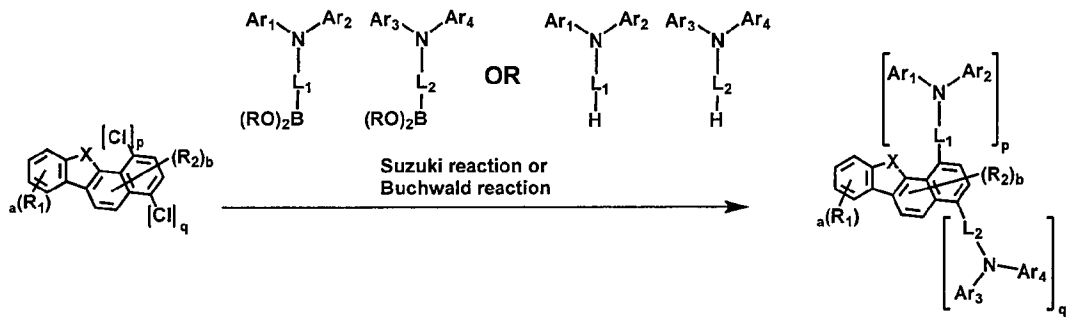
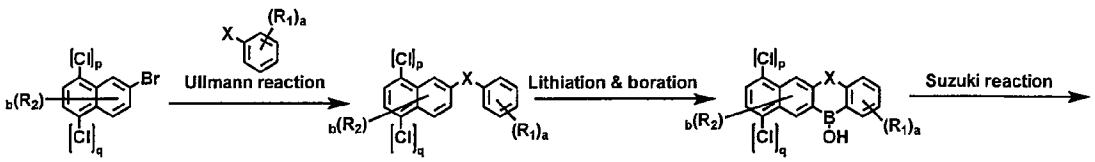
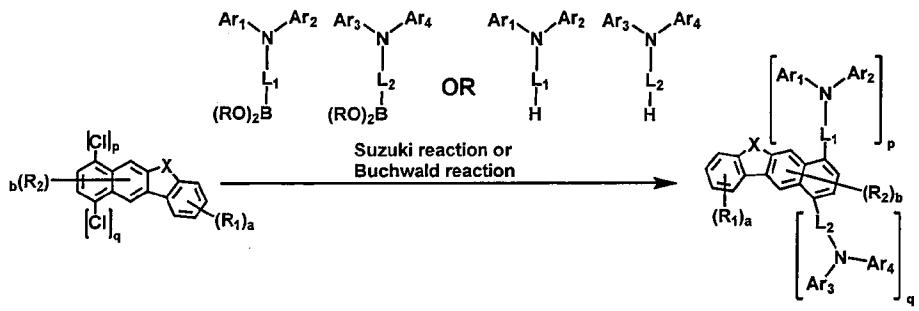
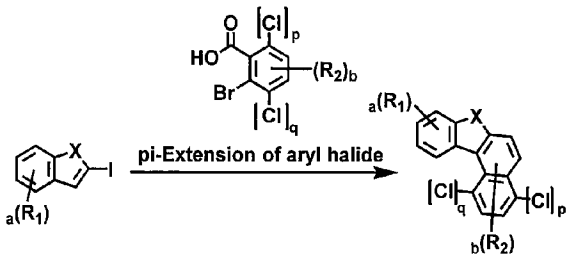


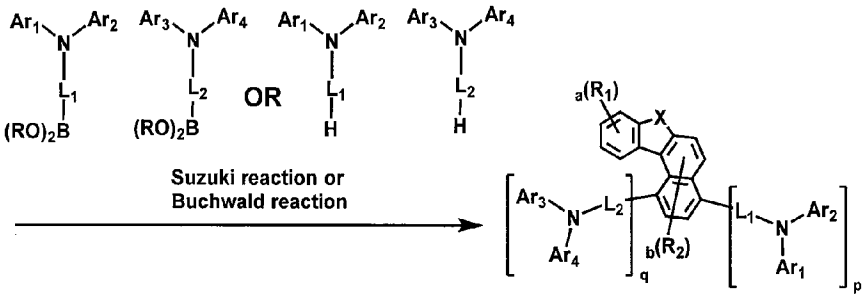
[88] **[Reaction Scheme 2]**

[89] 

[90] 

[91] **[Reaction Scheme 3]**

[92] 

[93] 

[94] In reaction schemes 1 to 3, X, Ar_1 to Ar_4, L_1, L_2, R_1, R_2, a, b, p and q are as defined in formula 1.

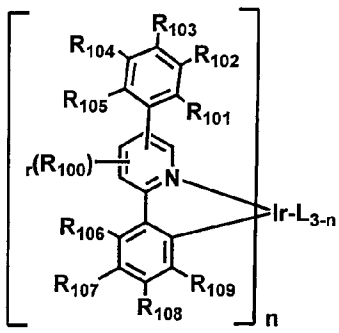
[95] As described above, exemplary synthesis examples of the compounds represented by formulae 2 to 4 according to one embodiment are described, but they are based on Buchwald-Hartwig cross coupling reaction, Wittig reaction, Ullmann-coupling reaction, Suzuki cross-coupling reaction, N-arylation reaction, H-mont-mediated etherification reaction, Miyaura borylation reaction, Intramolecular acid-induced cyclization reaction, Pd(II)-catalyzed oxidative cyclization reaction, Grignard reaction, Heck reaction, Cyclic Dehydration reaction, SN_1 substitution reaction, SN_2 substitution reaction, and Phosphine-mediated reductive cyclization reaction, etc. It will be understood by one skilled in the art that the above reaction proceeds even if other substituents defined in the formulae 2 to 4 other than the substituents described in the

specific synthesis examples are bonded.

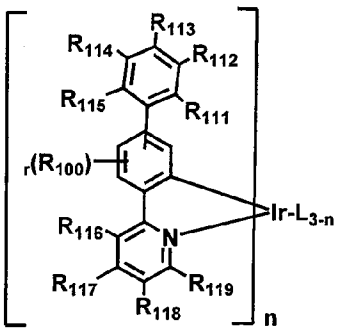
[96] The dopant which can be used in combination with the compound of the present disclosure may be at least one phosphorescent or fluorescent dopant, preferably a phosphorescent dopant. The phosphorescent dopant is not particulary limited, but may be a metallated complex compound(s) of a metal atom(s) selected from iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), preferably an ortho-metallated complex compound(s) of a metal atom(s) selected from iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), and even more preferably ortho-metallated iridium complex compound(s).

[97] The dopant may use the compound represented by any one of by the following formulae 101 to 103, but is not limited thereto:

[98]

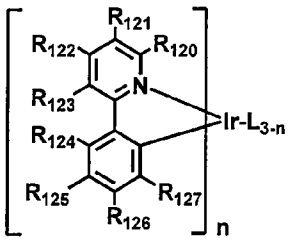


--- (101)



--- (102)

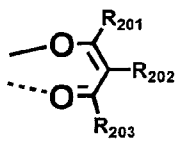
[99]



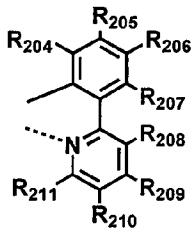
--- (103)

[100] wherein, L is selected from the following structure 1 or 2:

[101]



--- structure (1)



--- structure (2)

[102] R_{100} each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl;

[103] R_{101} to R_{109} and R_{111} to R_{123} each independently represent hydrogen, deuterium, halogen, deuterium- or halogen-substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, cyano, or a substituted or unsubstituted (C1-C30)alkoxy; or may be

linked to an adjacent substituent(s) to form a ring; specifically, R_{106} to R_{109} may be linked to an adjacent substituent(s) to form a ring, e.g., alkyl-substituted or unsubstituted indene ring, alkyl-substituted or unsubstituted benzothiophene ring, or alkyl-substituted or unsubstituted benzofuran ring; R_{120} to R_{123} may be linked to an adjacent substituent(s) to form a ring, e.g., R_{120} and R_{121} may be linked to each other to form at least one of alkyl-, aryl-, aralkyl- and alkylaryl-substituted or unsubstituted benzene ring, or at least one alkyl-substituted or unsubstituted fluorene ring, dibenzofuran ring, or dibenzothiophene ring;

[104] R_{124} to R_{127} each independently represent hydrogen, deuterium, halogen, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C6-C30)aryl; or may be linked to an adjacent substituent(s) to form a ring, e.g., alkyl-substituted or unsubstituted indene ring, alkyl-substituted or unsubstituted benzothiophene ring, or alkyl-substituted or unsubstituted benzofuran ring;

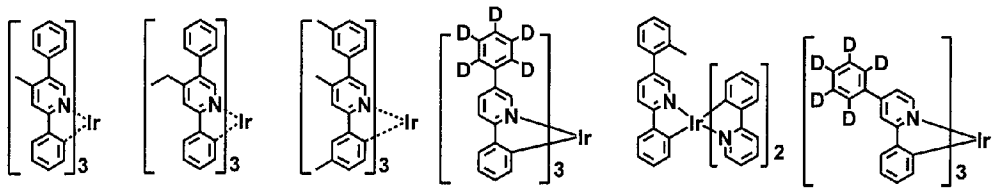
[105] R_{201} to R_{211} each independently represent hydrogen, deuterium, halogen, deuterium- or halogen-substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, or alkyl- or deuterium-substituted or unsubstituted (C6-C30)aryl; or may be linked to an adjacent substituent(s) to form a ring, e.g., alkyl-substituted or unsubstituted indene ring, alkyl-substituted or unsubstituted benzothiophene ring, or alkyl-substituted or unsubstituted benzofuran ring;

[106] r each independently represent an integer of 1 to 3; when r is 2 or more, each of R_{100} may be the same or different; and

[107] n represents an integer of 1 to 3.

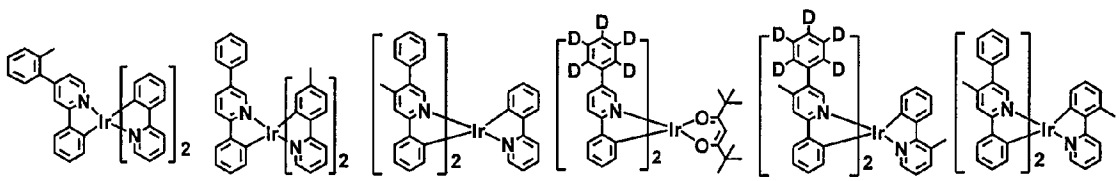
[108] The specific examples of the dopant compound include the following, but are not limited thereto.

[109]



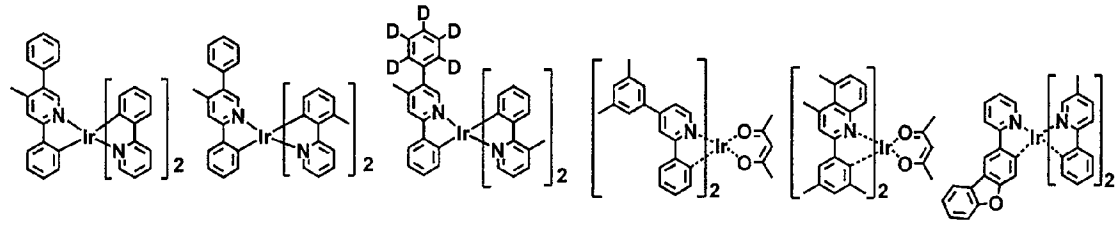
D-1 D-2 D-3 D-4 D-5 D-6

[110]



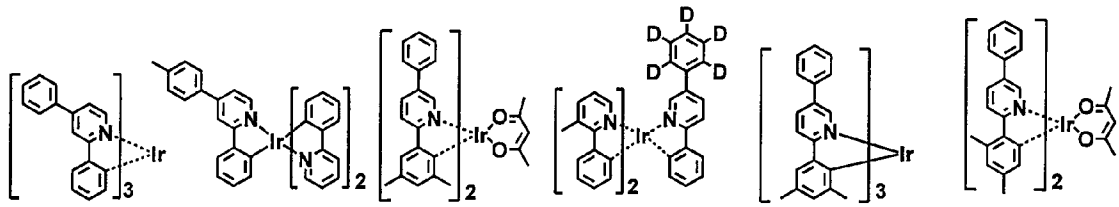
D-7 D-8 D-9 D-10 D-11 D-12

[111]



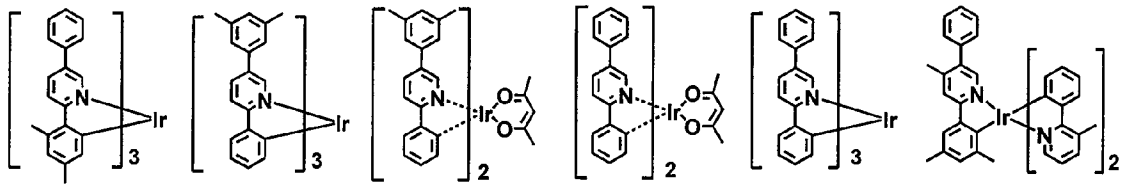
D-13 D-14 D-15 D-16 D-17 D-18

[112]



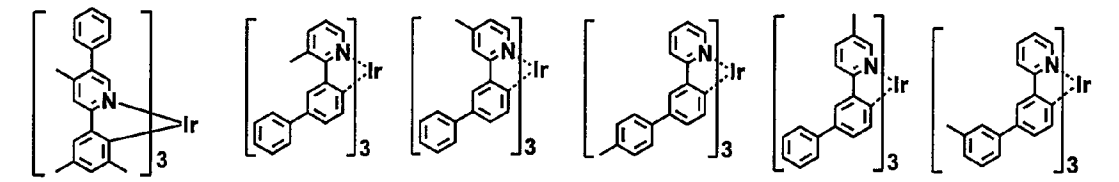
D-19 D-20 D-21 D-22 D-23 D-24

[113]



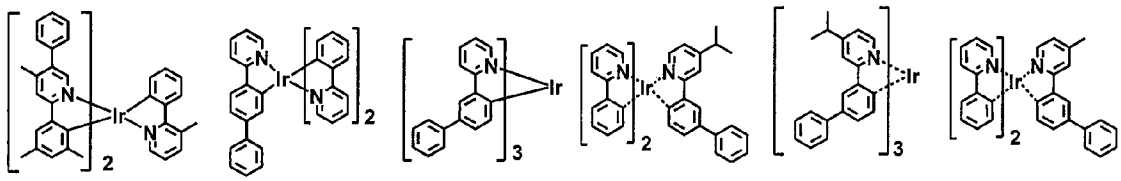
D-25 D-26 D-27 D-28 D-29 D-30

[114]



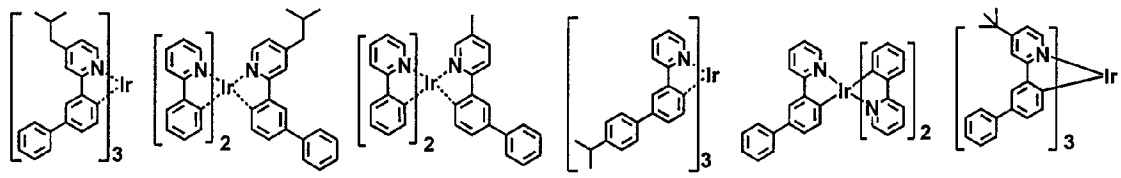
D-31 D-32 D-33 D-34 D-35 D-36

[115]



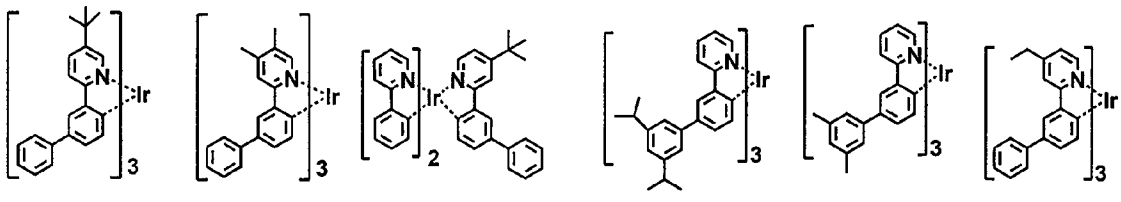
D-37 D-38 D-39 D-40 D-41 D-42

[116]



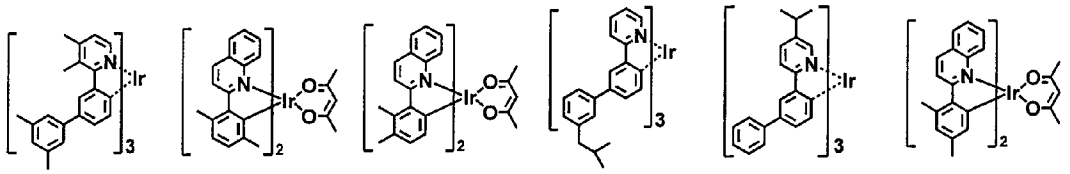
D-43 D-44 D-45 D-46 D-47 D-48

[117]



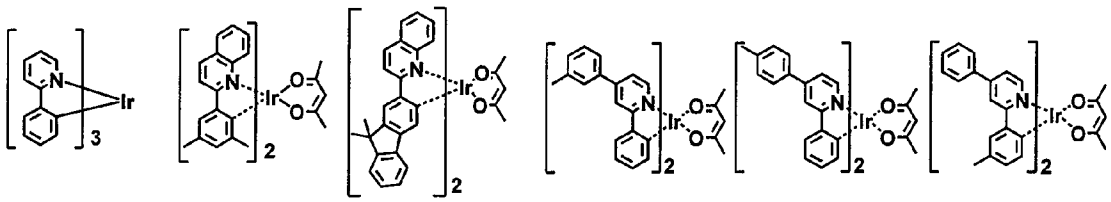
D-49 D-50 D-51 D-52 D-53 D-54

[118]



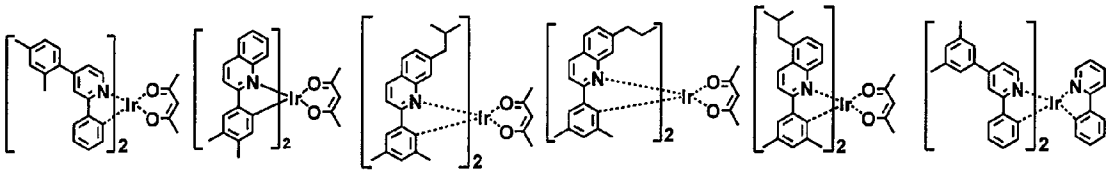
D-55 D-56 D-57 D-58 D-59 D-60

[119]



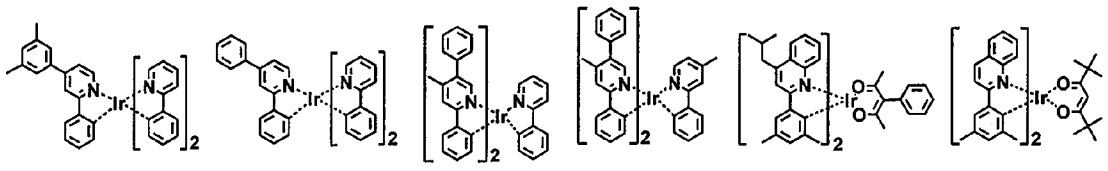
D-61 D-62 D-63 D-64 D-65 D-66

[120]



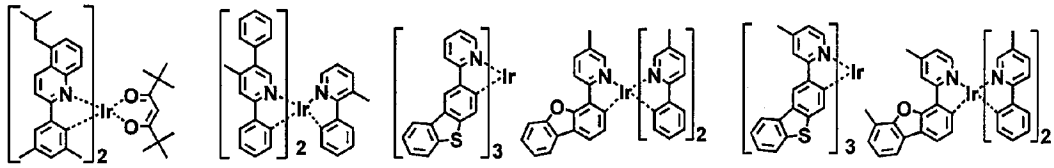
D-67 D-68 D-69 D-70 D-71 D-72

[121]



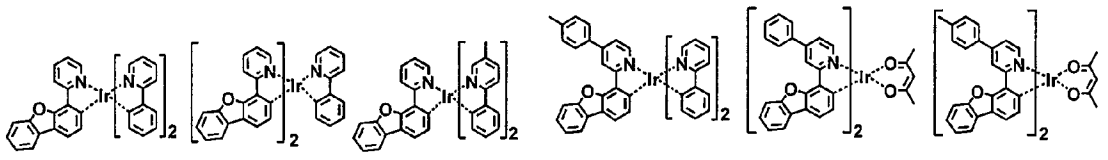
D-73 D-74 D-75 D-76 D-77 D-78

[122]



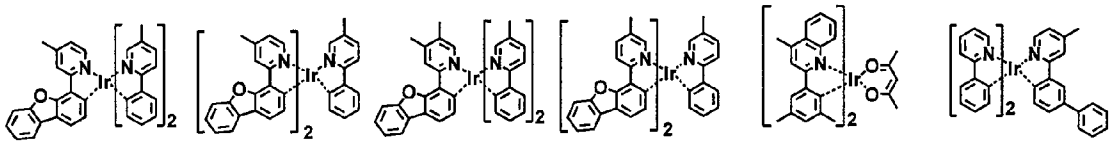
D-79 D-80 D-81 D-82 D-83 D-84

[123]



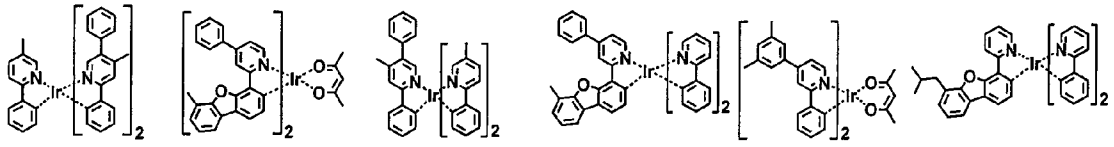
D-85 D-86 D-87 D-88 D-89 D-90

[124]



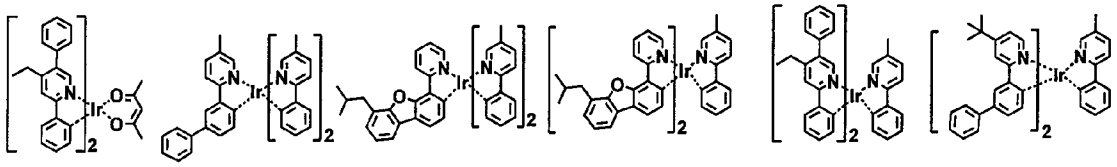
D-91 D-92 D-93 D-94 D-95 D-96

[125]



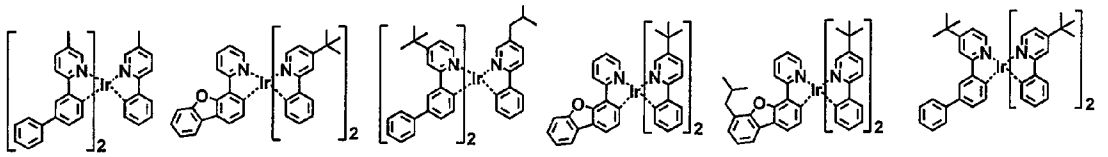
D-97 D-98 D-99 D-100 D-101 D-102

[126]



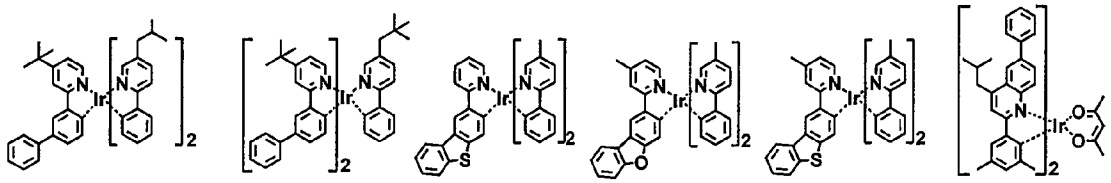
D-103 D-104 D-105 D-106 D-107 D-108

[127]



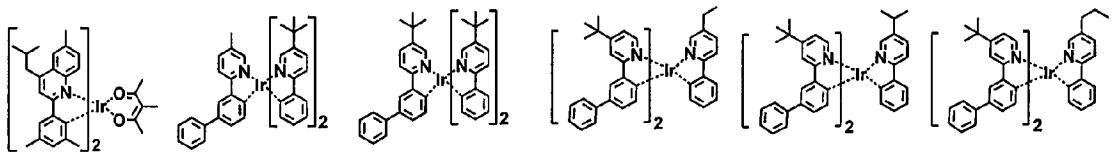
D-109 D-110 D-111 D-112 D-113 D-114

[128]



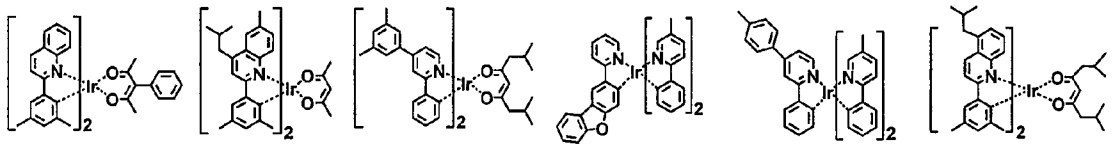
D-115 D-116 D-117 D-118 D-119 D-120

[129]



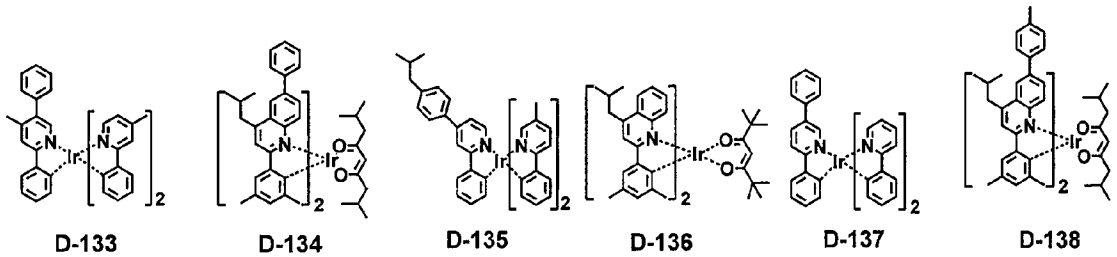
D-121 D-122 D-123 D-124 D-125 D-126

[130]



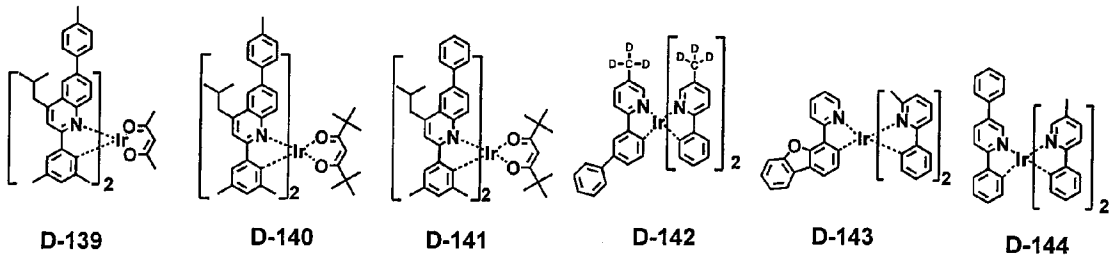
D-127 D-128 D-129 D-130 D-131 D-132

[131]



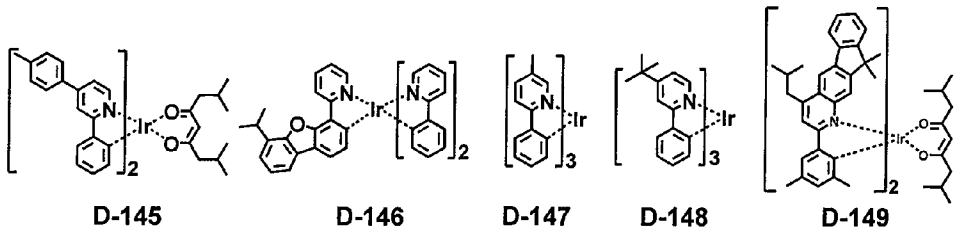
D-133 D-134 D-135 D-136 D-137 D-138

[132]



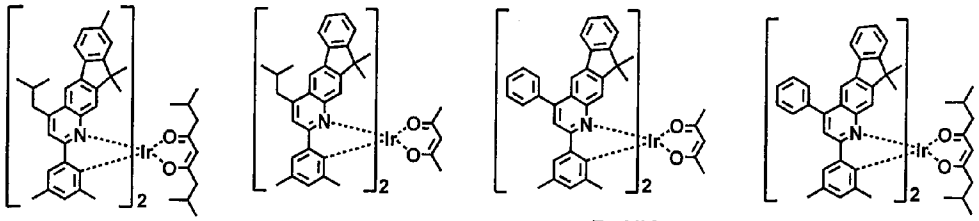
D-139 D-140 D-141 D-142 D-143 D-144

[133]



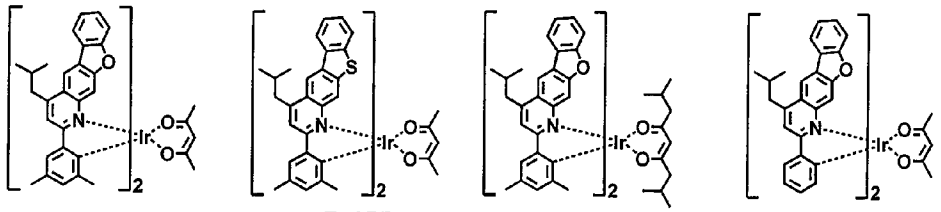
D-145 D-146 D-147 D-148 D-149

[134]



D-150 D-151 D-152 D-153

[135]



D-154 D-155 D-156 D-157

[136] The compound represented by formula 1 of the present disclosure may be contained in at least one layer, e.g., at least one layer selected from a hole injection layer, a hole transport layer, a hole auxiliary layer, a light-emitting auxiliary layer, an electron transport layer, an electron buffer layer, an electron injection layer, an interlayer, a hole blocking layer, and an electron blocking layer, constituting the organic electroluminescent device. In addition, the compound represented by formula 1 of the present disclosure may be contained in a hole transport zone, preferably a second hole transport layer of the hole transport zone, but is not limited thereto.

[137] The organic electroluminescent material, e.g., at least one material of a hole injection material, a hole transport material, a hole auxiliary material, a light-emitting auxiliary material, an electron blocking material, a light-emitting material, an electron buffer material, a hole blocking material, an electron transport material, and an electron injection material, may comprise the compound represented by formula 1 above. The materials may be a hole transport zone material. The hole transport zone material may be comprised solely of the organic electroluminescent compound represented by

formula 1, or may further comprise conventional materials included in the organic electroluminescent material.

[138] An organic electroluminescent material according to one embodiment may be used as light-emitting materials for a white organic light-emitting device. The white organic light-emitting device has suggested various structures such as a parallel side-by-side arrangement method, a stacking arrangement method, or CCM (color conversion material) method, etc., according to the arrangement of R (Red), G (Green), B (blue), or YG (yellowish green) light-emitting units. In addition, the organic electroluminescent material according to one embodiment may also be applied to the organic electroluminescent device comprising a QD (quantum dot).

[139] The organic electroluminescent device according to the present disclosure includes a first electrode; a second electrode; and at least one organic layer interposed between the first electrode and the second electrode. One of the first electrode and the second electrode may be an anode and the other may be a cathode. Wherein, the first electrode and the second electrode may each be formed as a transmissive conductive material, a transflective conductive material, or a reflective conductive material. The organic electroluminescent device may be a top emission type, a bottom emission type, or a both-sides emission type according to the kinds of the material forming the first electrode and the second electrode. The organic layer may comprise at least one light-emitting layer, and may further comprise at least one layer selected from a hole injection layer, a hole transport layer, a hole auxiliary layer, a light-emitting auxiliary layer, an electron transport layer, an electron buffer layer, an electron injection layer, an interlayer, a hole blocking layer, and an electron blocking layer.

[140] The organic electroluminescent device according to the present disclosure layer may comprise the organic electroluminescent compound represented by formula 1 above, and may further comprise conventional materials included in the organic electroluminescent material. The organic electroluminescent device comprising the organic electroluminescent compound represented by formula 1 above may represent high luminous efficiency and/or long lifespan characteristics.

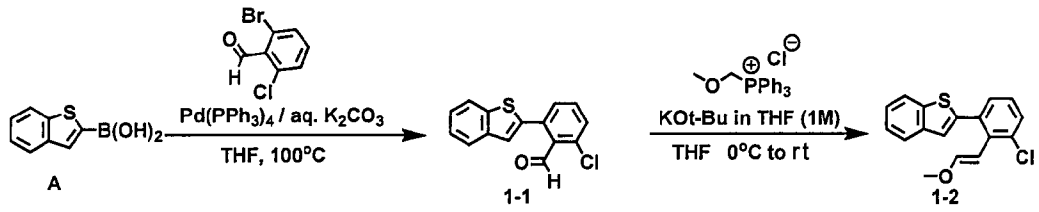
[141] In addition, the present disclosure can provide a display device by using the compound represented by the formula 1. That is, it is possible to manufacture a display device or a lighting device using the compound of the present disclosure. Specifically, the organic electroluminescent compound of the present disclosure can be used for the manufacture of display devices such as smartphones, tablets, notebooks, PCs, TVs, or display devices for vehicles, or lighting devices such as outdoor or indoor lighting.

[142] Hereinafter, the preparation method of a compound according to the present disclosure, and the properties thereof will be represented in detail with reference to the representative compounds of the present disclosure in order to understand the present

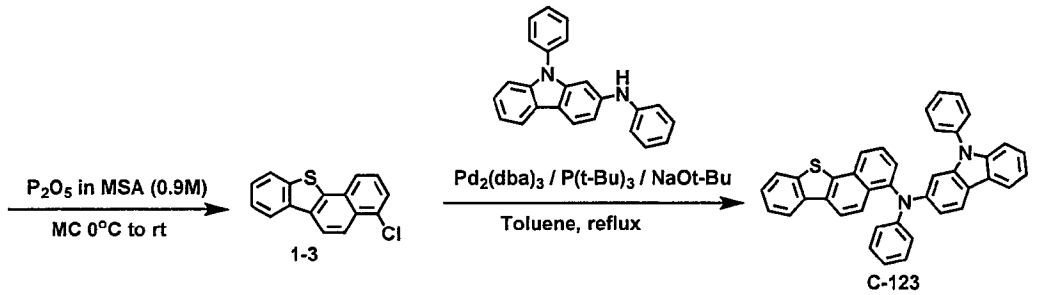
disclosure in detail. However, the present disclosure is not limited to the following examples.

[143] **[Example 1] Preparation of Compound C-123**

[144]



[145]



[146] **1) Preparation of Compound 1-1**

[147] Compound **A** (37 g, 205.05 mmol), 2-bromo-6-chlorobenzaldehyde (30 g, 136.7 mmol), tetrakis(triphenylphosphine)palladium (4.7 g, 4.1 mmol), potassium carbonate (47.2 g, 341.75 mmol), 400 mL of tetrahydrofuran, and 100 mL of distilled water were added into a reaction vessel and stirred for 4 hours at 100℃. After completion of the reaction, the reaction mixture was washed with distilled water and extracted with ethyl acetate. After the extracted organic layer was dried with magnesium sulfate, the solvent was removed therefrom with a rotary evaporator. Thereafter, the remaining product was purified by column chromatography to obtain compound **1-1** (35 g, yield: 94%).

[148] **2) Preparation of Compound 1-2**

[149] Compound **1-1** (35 g, 128.32 mmol) and (methoxymethyl)triphenylphosphinium chloride (66 g, 192.48 mmol) were added into a reaction vessel in 350 mL of tetrahydrofuran; thereafter, 193 mL of potassium *tert*-butoxide (1M) was added dropwise to the mixture at 0℃. After completion of dropwise addition, the reaction temperature was slowly raised to room temperature and further the mixture was stirred for 2 hours. After completion of the reaction, the reaction mixture was extracted with ethyl acetate and the extracted organic layer was dried with magnesium sulfate. Thereafter, the solvent was removed therefrom with a rotary evaporator and then the remaining product was purified by column chromatography to obtain compound **1-2** (31g, yield: 80%).

[150] **3) Preparation of Compound 1-3**

[151] After compound **1-2** (31 g, 103.06 mmol) was dissolved in chlorobenzene, 3.1 mL of

Eaton's reagent was added slowly dropwise to a reaction vessel. After completion of dropwise addition, the mixture was further stirred for 2 hours. After completion of the reaction, the reaction mixture was washed with distilled water and extracted with ethyl acetate. After the extracted organic layer was dried with magnesium sulfate, the solvent was removed therefrom with a rotary evaporator. Thereafter, the remaining product was purified by column chromatography to obtain compound **1-3** (24.4 g, yield: 88%).

[152] **4) Preparation of Compound C-123**

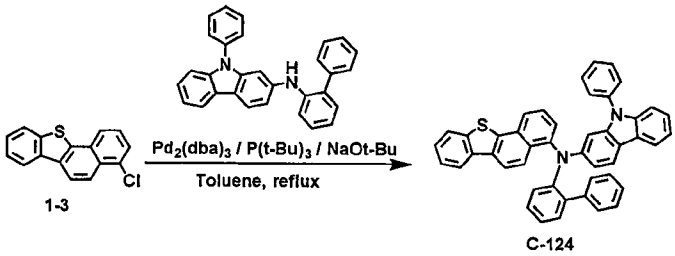
[153] Compound **1-3** (3.5 g, 13.02 mmol), N,9-diphenyl-9H-carbazole-2-amine (4.8 g, 14.33 mmol), tris(dibenzylideneacetone)dipalladium(0) (0.6 g, 0.65 mmol), tri-*tert*-butylphosphine (0.3 mL, 1.30 mmol), sodium *tert*-butoxide (1.9 g, 19.53 mmol), and 65 mL of toluene were added into a reaction vessel and refluxed for 1 hour. The reaction mixture was cooled to room temperature; thereafter, the solid was filtered and washed with ethyl acetate. The filtrate was distilled under reduced pressure and purified by column chromatography to obtain the compound **C-123** (6 g, yield: 81%).

[154]

	MW	M.P.
C-123	566.71	255°C

[155] **[Example 2] Preparation of Compound C-124**

[156]



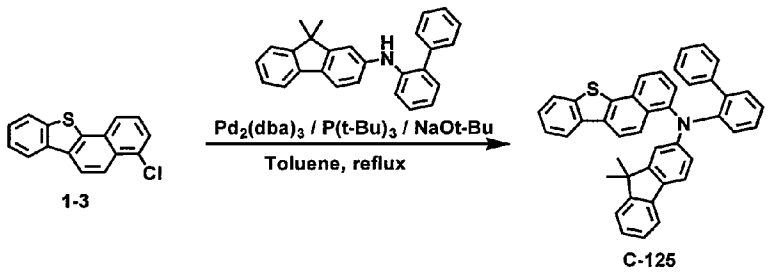
[157] Compound **1-3** (3.0 g, 11.16 mmol), N-([1,1'-biphenyl]-2-yl)-9-phenyl-9H-carbazole-2-amine (5.0 g, 12.28 mmol), tris(dibenzylideneacetone)dipalladium(0) (0.5 g, 0.56 mmol), tri-*tert*-butylphosphine (0.3 mL, 1.12 mmol), sodium *tert*-butoxide (1.6 g, 16.74 mmol), and 56 mL of toluene were added into a reaction vessel and refluxed for 1 hour. The reaction mixture was cooled to room temperature; thereafter, the solid was filtered and washed with ethyl acetate. The filtrate was distilled under reduced pressure and purified by column chromatography to obtain the compound **C-124** (2 g, yield: 28%).

[158]

	MW	M.P.
C-124	642.81	228°C

[159] **[Example 3] Preparation of Compound C-125**

[160]



[161] Compound **1-3** (3.5 g, 13.02 mmol), N-([1,1'-biphenyl]-2-yl)-9,9-dimethyl-9H-fluorene-2-amine (5.2 g, 14.33 mmol), tris(dibenzylideneacetone)dipalladium(0) (0.6 g, 0.65 mmol), tri-*tert*-butylphosphine (0.3 mL, 1.30 mmol), sodium *tert*-butoxide (1.9 g, 19.53 mmol), and 65 mL of toluene were added into a reaction vessel and refluxed for1 hour. The reaction mixture was cooled to room temperature; thereafter, the solid was filtered and washed with ethyl acetate. The filtrate was distilled under reduced pressure and purified by column chromatography to obtain the compound **C-125** (1.3 g, yield: 17%).

[162]

	MW	M.P.
C-125	593.78	250°C

[163] Hereinafter, the properties of an organic electroluminescent device comprising the organic electroluminescent compound of the present disclosure will be explained in order to understand the present disclosure in detail. However, the following examples description is intended to explain the characteristics of an OLED according to the present disclosure in order to understand the present disclosure in detail, and the present disclosure is not meant in any way to restrict the following examples.

[164] **[Device Examples 1 to 3] Producing an OLED including the organic**

[165] **electroluminescent compound according to the present disclosure**

[166] An OLED was produced by using the organic electroluminescent compound of the present disclosure. First, a transparent electrode indium tin oxide (ITO) thin film (10 Ω/sq) on a glass substrate for an OLED (GEOMATEC CO., LTD., Japan) was subjected to an ultrasonic washing with acetone and isopropanol, sequentially, and then was stored in isopropanol. Next, the ITO substrate was mounted on a substrate holder of a vacuum vapor deposition apparatus. Compound **HI-1** was introduced into a cell of the vacuum vapor deposition apparatus, and the pressure in the chamber of the apparatus was then controlled to be 10^{-6} torr. Thereafter, an electric current was applied to the cell to evaporate the introduced material, thereby forming a first hole injection layer having a thickness of 90 nm on the ITO substrate. Compound **HI-2** was then introduced into another cell of the vacuum vapor deposition apparatus, and an electric current was applied to the cell to evaporate the introduced material, thereby forming a second hole injection layer having a thickness of 5 nm on the first hole injection layer.

Next, compound **HT-1** was introduced into another cell of the vacuum vapor deposition apparatus. Thereafter, an electric current was applied to the cell to evaporate the introduced material, thereby forming a first hole transport zone having a thickness of 10 nm on the second hole injection layer. The compound of the following Table 1 (a second hole transport material) was then introduced into another cell of the vacuum vapor deposition apparatus, and an electric current was applied to the cell to evaporate the introduced material, thereby forming a second hole transport zone (an auxiliary layer) having a thickness of 60 nm on the first hole transport zone. After forming the hole injection layers and the hole transport zones, a light-emitting layer was then deposited as follows. Compound **H-1** as host was introduced into one cell of the vacuum vapor deposition apparatus and compound **D-71** as a dopant was introduced into another cell of the apparatus. The dopant was deposited in a doping amount of 2 wt%, based on the total weight of the host and dopant, to form a light-emitting layer having a thickness of 40 nm on the hole transport zone. Next, compounds **ET-1** and **EI-1** were introduced into another cell, were evaporated at a rate of 1:1, and were deposited to form an electron transport layer having a thickness of 35 nm on the light-emitting layer. Next, compound **EI-1** as an electron injection layer having a thickness of 2 nm was deposited on the electron transport layer, and an Al cathode having a thickness of 1500 nm was deposited by another vacuum vapor deposition apparatus on the electron injection layer, and thereby the OLED was produced.

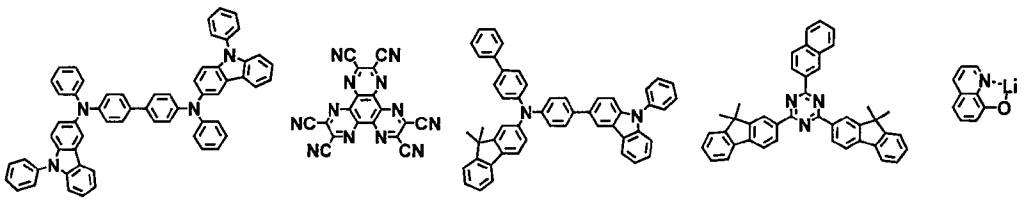
[167] **[Comparative Examples 1 and 2] Producing an OLED using the compound not**

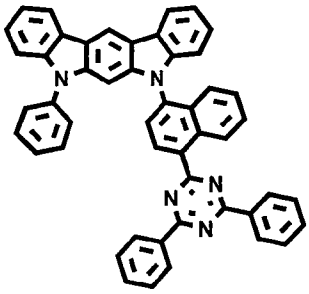
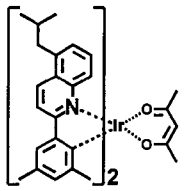
[168] **according to the present disclosure**

[169] OLEDs were produced in the same manner as in Device Examples 1 to 3, except that the compound of the following Table 1 was used in the second hole transport zone.

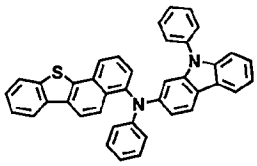
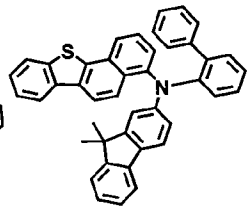
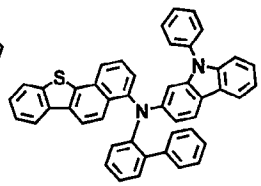
[170] The compounds used in Device Examples 1 to 3 and Comparative Examples 1 and 2 are shown as follows.

[171]

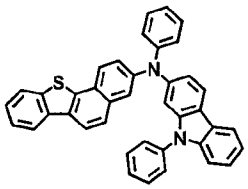
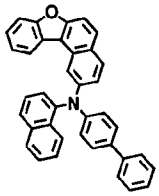


[172]  

H-1 D-71

[173]   

C-123 C-125 C-124

[174]  

T-1 T-2

[175] The results of the driving voltage, the power efficiency, and CIE color coordinates at a luminance of 1,000 nit of the OLEDs produced as described above, are shown in the following Table 1.

[176] **Table 1**

	Compound (Second Hole transport Material)	Driving Voltage [V]	Power Efficiency [Lm/W]	CIE	
				x	y
Device Example1	**C-123**	**2.9**	**26.1**	**0.667**	**0.332**
Device Example 2	**C-125**	**2.8**	**29.4**	**0.669**	**0.330**
Device Example 3	**C-124**	**2.8**	**26.6**	**0.668**	**0.331**
Comparative Example 1	**T-1**	**3.1**	**16.6**	**0.662**	**0.335**
Comparative Example 2	**T-2**	**3.8**	**19.8**	**0.669**	**0.331**

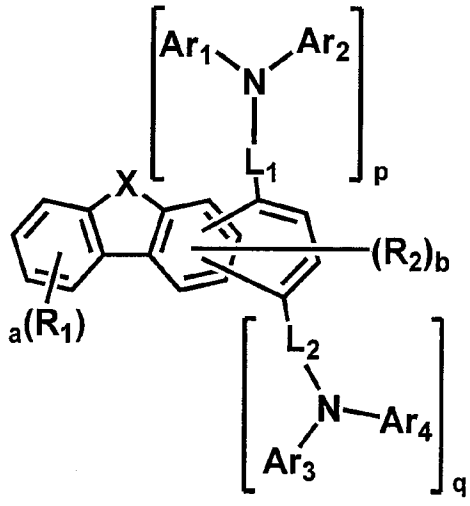
[177] In addition, the time taken to reduce to 98% at a constant current based on a

luminance of 5,000 nit (lifespan; T98), of Device Example 2 and Comparative Example 1, is 98 hrs and 18 hrs, respectively.

[178] In the Device Examples and Comparative Examples above, it was confirmed that the organic electroluminescent device comprising the organic electroluminescent compound of the present disclosure has a low driving voltage and/or high power efficiency compared with the organic electroluminescent device not comprising the compound of the present disclosure. At the same time or selectively, the organic electroluminescent device comprising the organic electroluminescent compound of the present disclosure may have improved lifespan characteristics.

Claims

[Claim 1] An organic electroluminescent compound represented by the following formula 1:



--- (1)

wherein,

X represents O or S;

Ar_1 to Ar_4 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted mono- or di-(C1-C30)alkylamino, a substituted or unsubstituted mono- or di-(C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or Ar_1 and Ar_2, and Ar_3 and Ar_4 may be linked to each other to form a ring;

L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;

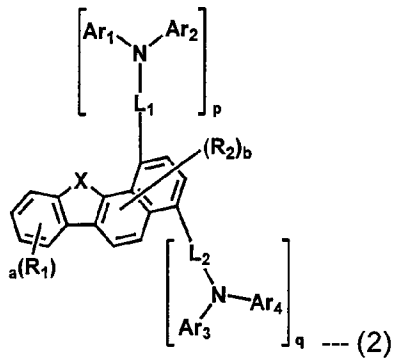
R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino;

a represents an integer of 1 to 4, b represents an integer of 1 to 5, and when a and b are 2 or more, each of R_1 and each of R_2 may be the same or different; and

p and q each independently represent 0 or 1, provided that the sum of p and q is 1 or 2, and when the sum of p and q is 2, L_1 and L_2, and Ar_1 to Ar_4 may be the same or different.

[Claim 2] The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted (C1-C30)alkyl, the substituted (C6-C30)aryl(ene), the substituted (3- to 30-membered)heteroaryl(ene), the substituted (C3-C30)cycloalkyl, the substituted (C1-C30)alkoxy, the substituted tri(C1-C30)alkylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the substituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted tri(C6-C30)arylsilyl, the substituted mono- or di- (C1-C30)alkylamino, the substituted mono- or di- (C6-C30)arylamino, and the substituted (C1-C30)alkyl(C6-C30)arylamino each independently represent at least one selected from the group consisting of deuterium, halogen, cyano, carboxyl, nitro, hydroxyl, (C1-C30)alkyl, halo(C1-C30)alkyl, (C2-C30)alkenyl, (C2-C30)alkynyl, (C1-C30)alkoxy, (C1-C30)alkylthio, (C3-C30)cycloalkyl, (C3-C30)cycloalkenyl, (3- to 7-membered)heterocycloalkyl, (C6-C30)aryloxy, (C6-C30)arylthio, (C6-C30)aryl-substituted or unsubstituted (3- to 30-membered)heteroaryl, (3- to 30-membered)heteroaryl-substituted or unsubstituted (C6-C30)aryl, tri(C1-C30)alkylsilyl, tri(C6-C30)arylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, (C1-C30)alkyldi(C6-C30)arylsilyl, amino, mono- or di- (C1-C30)alkylamino, (C1-C30)alkyl-substituted or unsubstituted mono- or di- (C6-C30)arylamino, (C1-C30)alkyl(C6-C30)arylamino, (C1-C30)alkylcarbonyl, (C1-C30)alkoxycarbonyl, (C6-C30)arylcarbonyl, di(C6-C30)arylboronyl, di(C1-C30)alkylboronyl, (C1-C30)alkyl(C6-C30)arylboronyl, (C6-C30)ar(C1-C30)alkyl, and (C1-C30)alkyl(C6-C30)aryl.

[Claim 3] The organic electroluminescent compound according to claim 1, wherein the formula 1 is represented by any one of the following formulae 2 to 4:



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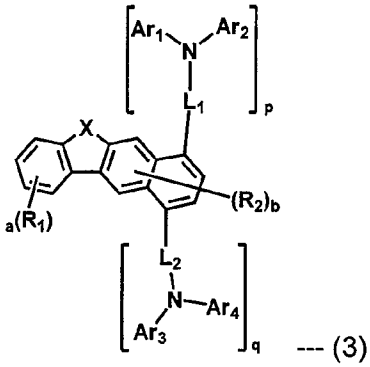
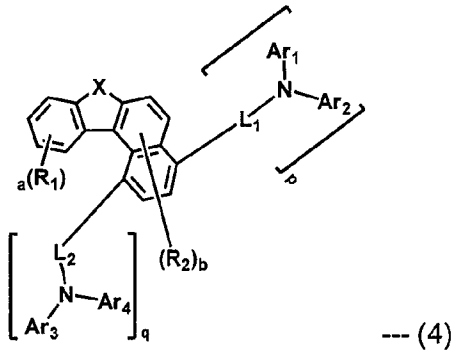


--- (3)



--- (4)

wherein,

p and q each independently represent 0 or 1, whrein the sum of p and q is 1; and

X, Ar_1 to Ar_4, L_1, L_2, R_1, R_2, a, and b are as defined in claim 1.

[Claim 4] The organic electroluminescent compound according to claim 1, Ar_1 to Ar_4 each independently represent a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C6-C25)aryl, a substituted or unsubstituted (3- to 25-membered)heteroaryl, a substituted or unsubstituted mono- or di- (C1-C20)alkylamino, a substituted or unsubstituted mono- or di- (C6-C25)arylamino, or a substituted or unsubstituted (C1-C20)alkyl(C6-C25)arylamino;

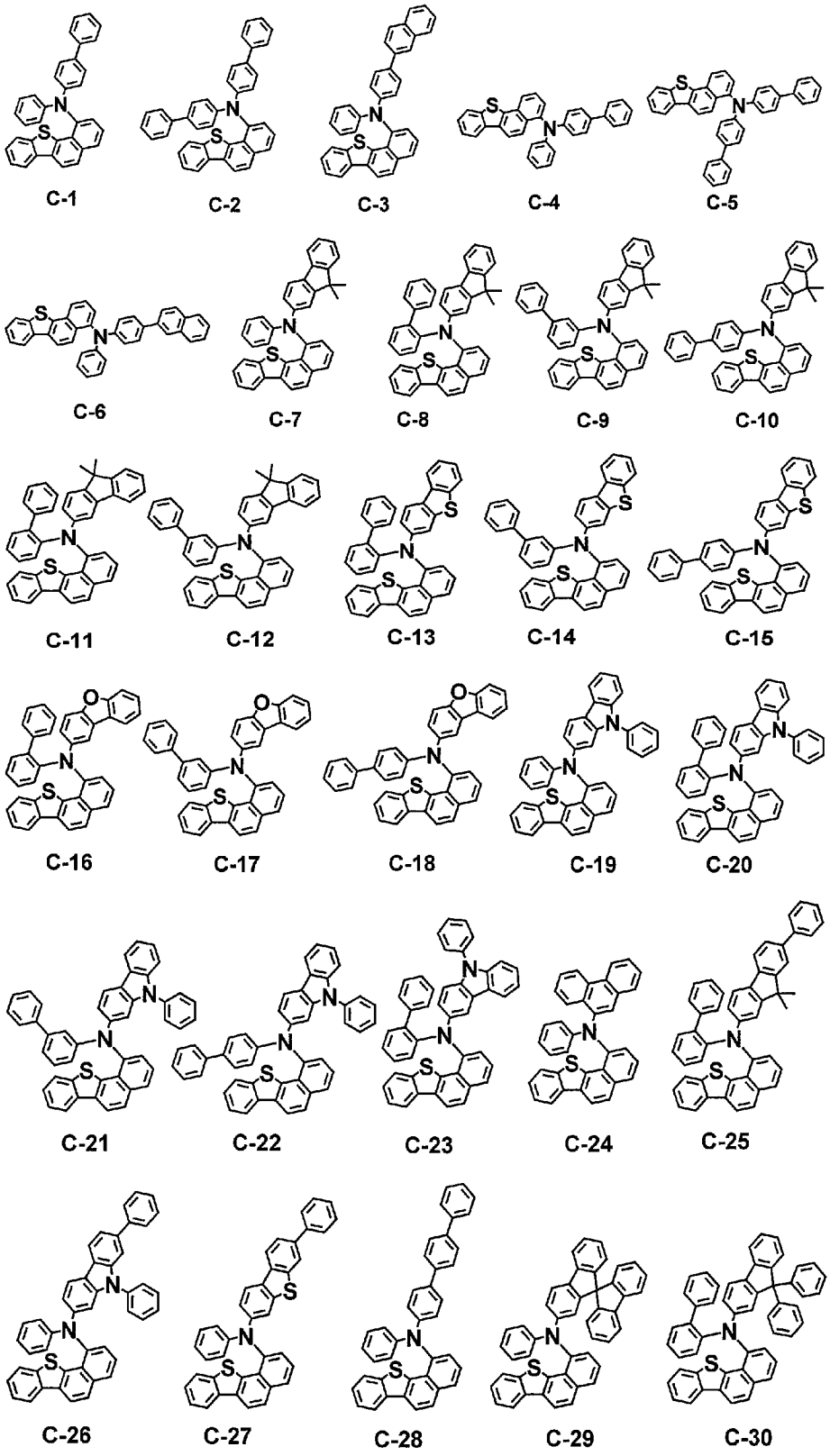
L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted (C6-C25)arylene, or a substituted or unsubstituted (3- to 25-membered)heteroarylene;

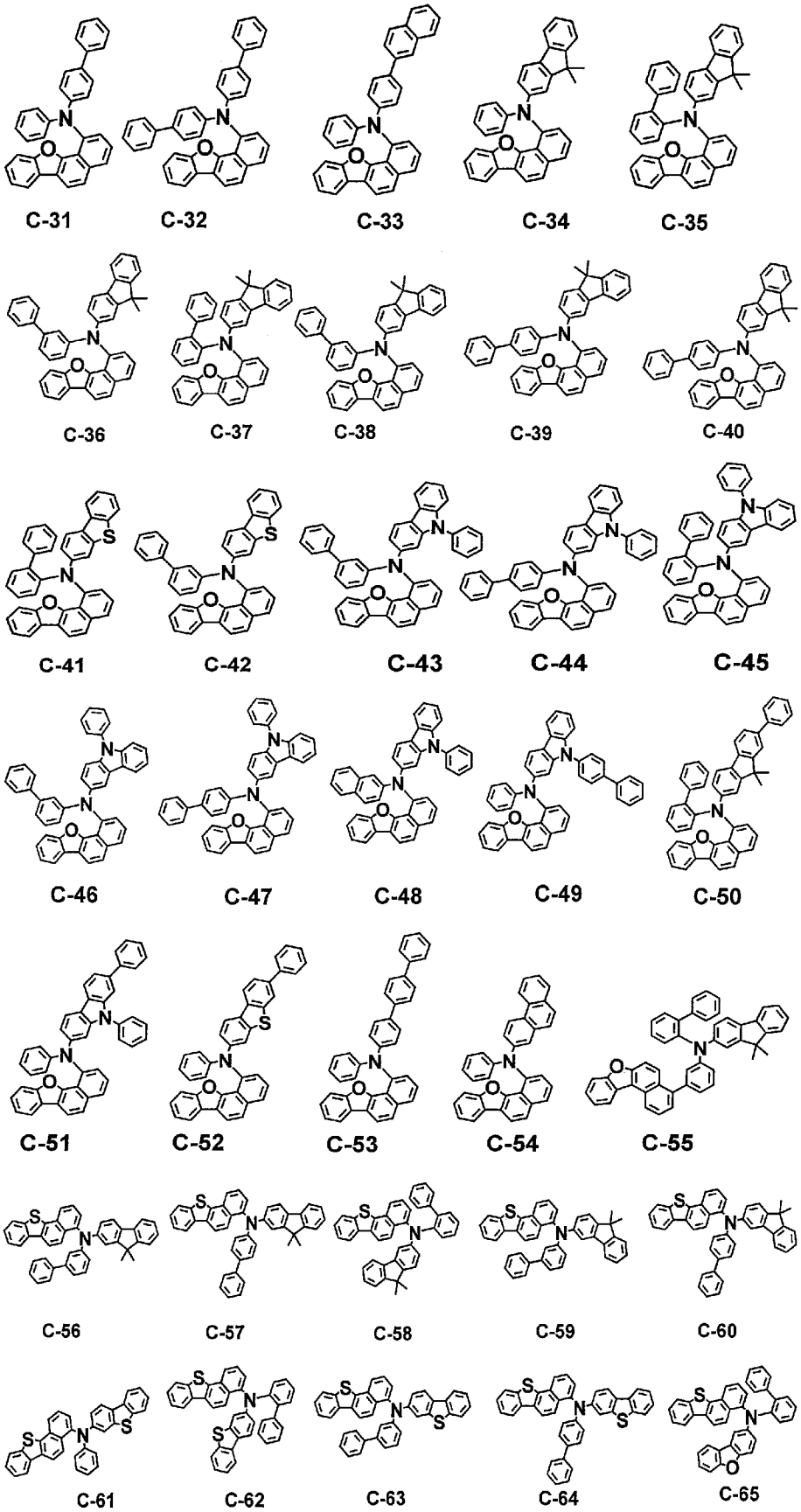
R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (3- to 25-membered)heteroaryl; and

p and q each independently represent 0 or 1, provided that the sum of p and q is 1.

[Claim 5] The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the

group consisting of:

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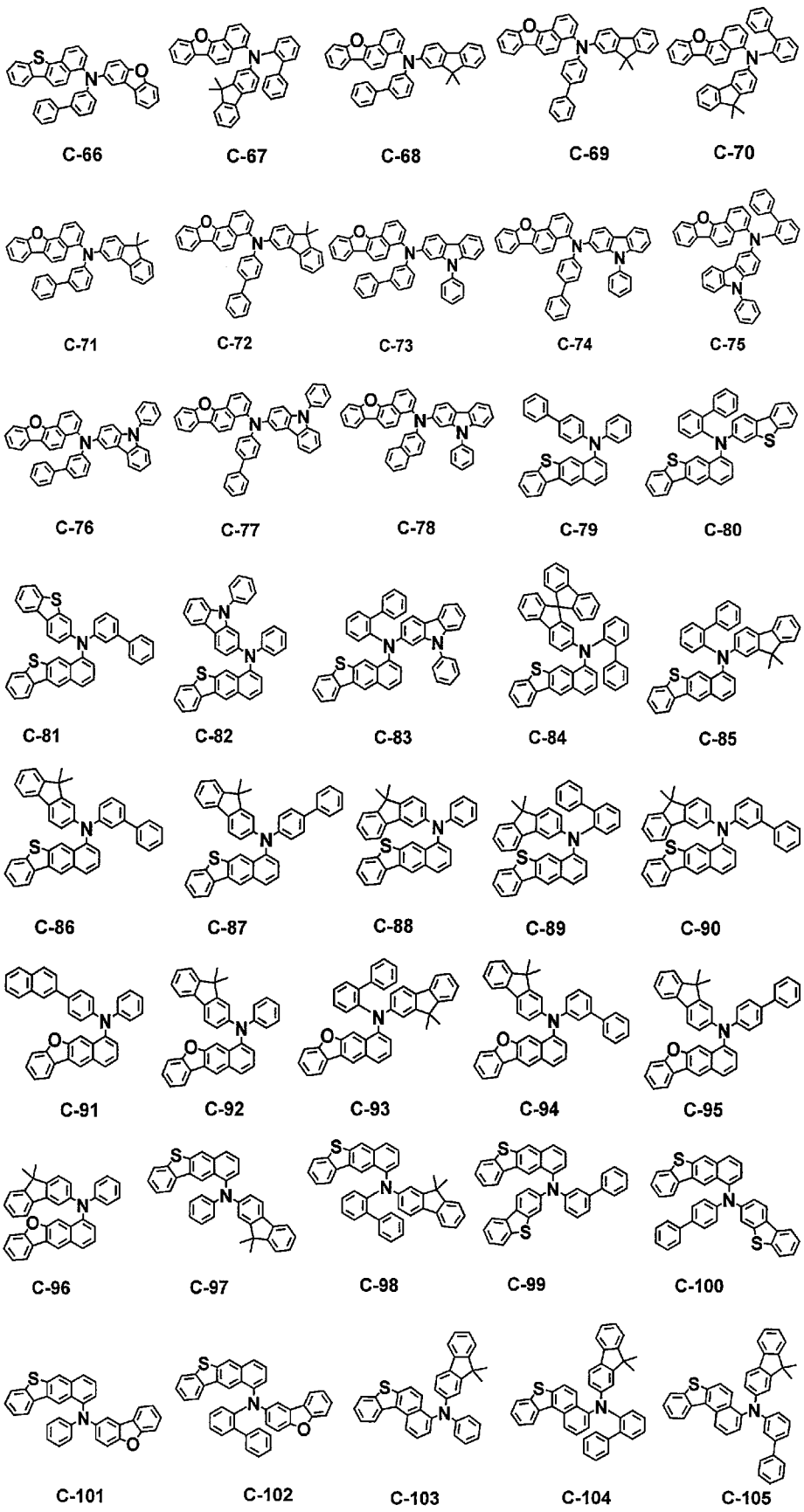
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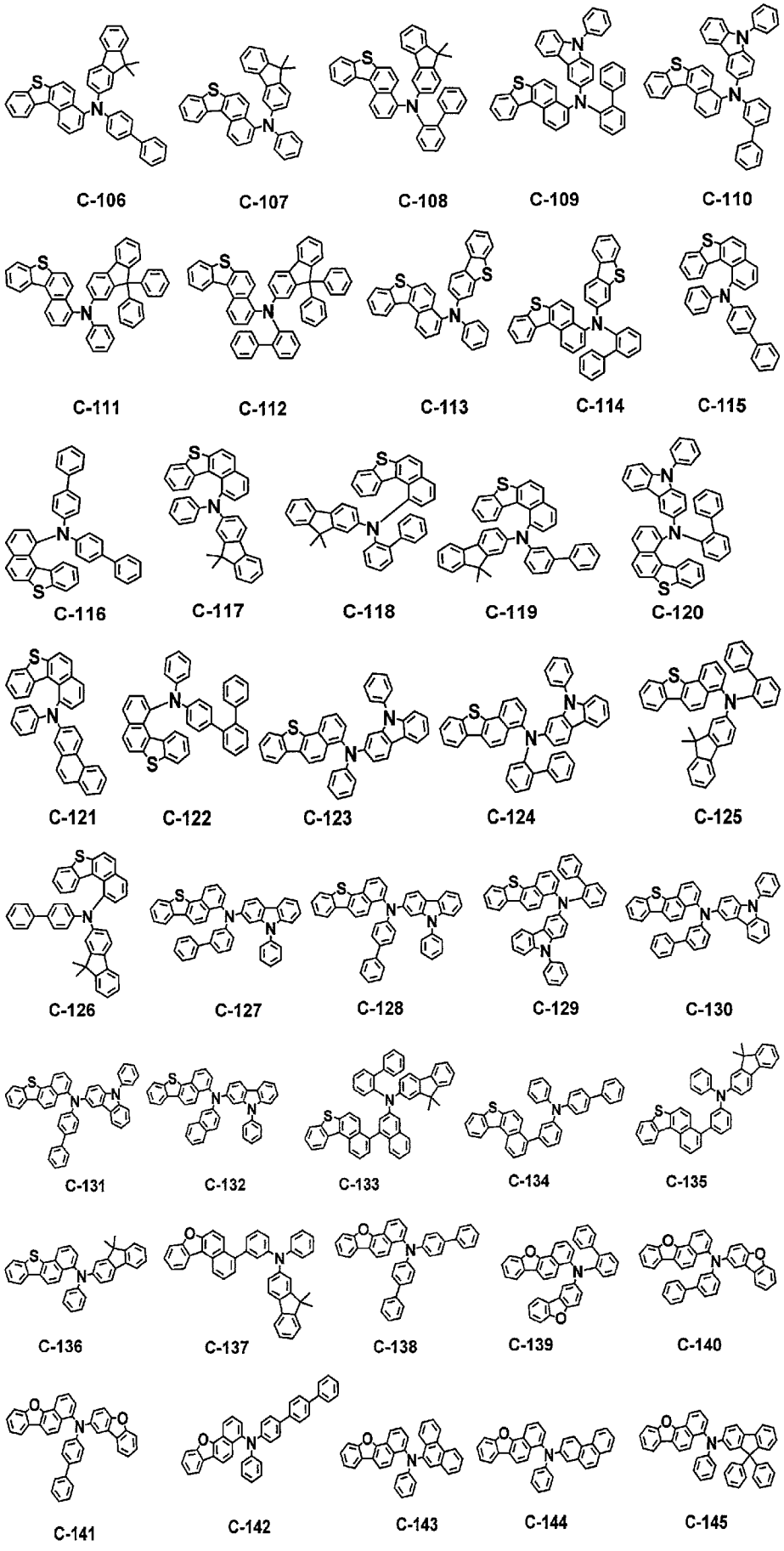
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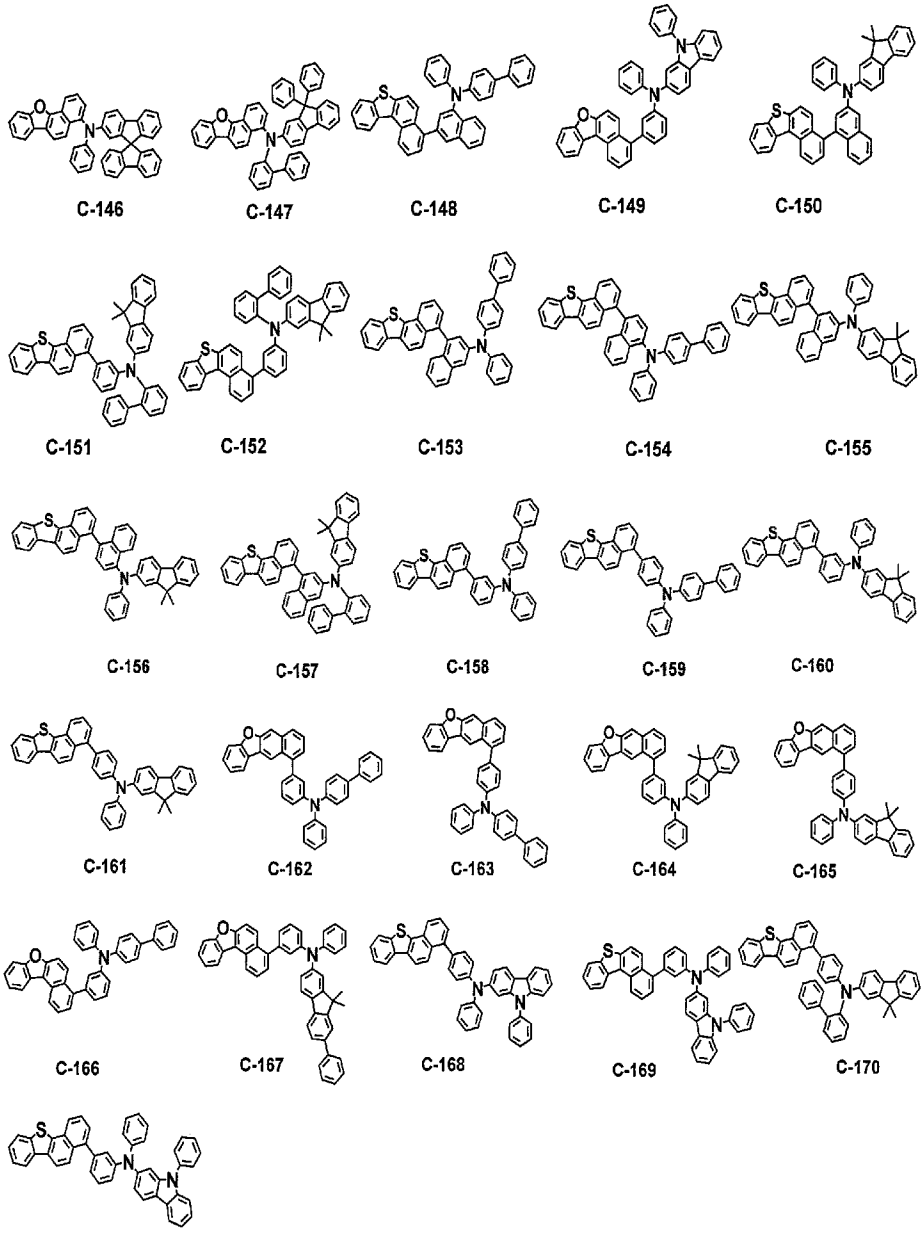

and C-171

[Claim 6] An organic electroluminescent material comprising the organic electroluminescent compound according to claim 1.

[Claim 7] An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.

[Claim 8] The organic electroluminescent device according to claim 7, wherein the organic electroluminescent compound is contained in a hole transport zone.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2019/007999

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06(2006.01)i, H01L 51/50(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C09K 11/06; C07C 211/54; C07D 209/56; C07D 307/77; C07D 307/91; C07D 333/76; C07D 487/04; C07D 491/048; H01L 51/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal), STN(Registry, Caplus) & Keywords: organic electroluminescent device, benzonaphthothiophene, benzonaphthofuran, hole transport zone

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2017-0030289 A (SAMSUNG SDI CO., LTD.) 17 March 2017 See claims 1, 7, 8; paragraphs [0005], [0006], [0064]; compounds A-33, A-34, A-37, A-38, A-45 - A-48, A-92, A-93 etc..	1-8
X	KR 10-2016-0139159 A (DUK SAN NEOLUX CO., LTD.) 07 December 2016 See claims 1, 2, 4-6; compound P-24.	1-8
X	KR 10-2017-0130737 A (DUK SAN NEOLUX CO., LTD.) 29 November 2017 See claims 1, 5, 14, 16, 21; compound 1-80'.	1-8
A	KR 10-2017-0096770 A (LG CHEMICAL LTD.) 25 August 2017 See the whole documents.	1-8
A	KR 10-2018-0011980 A (SFC LTD.) 05 February 2018 See the whole documents.	1-8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2019 (23.09.2019)	**24 September 2019 (24.09.2019)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2019/007999

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KR 10-2018-0011980 A	05/02/2018	None	